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TECHNICAL MEMORANDUM # M-2
ANALYSIS OF COMMON INORGANIC ANIONS
IN SURFACE AND GROUND WATER
AND
AMBIENT AIR QUALITY MONITORING FOR LEAD AND TSP

JOHNS-MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS

SEPTEMBER, 1985



KUMAR MALHOTRA & ASSOCIATES, INC.
ENGINEERS • CONSULTANTS • PLANNERS
Grand Rapids, Michigan/Monroe, Wisconsin

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• ENGINEERS • CONSULTANTS • PLANNERS •

KUMAR MALHOTRA & ASSOCIATES INC.

3000 East Belt Line N.E.
Grand Rapids, Michigan 49505
Telephone (616) 361-5092

September 10, 1985

Mr. Rodney Gaither
Project Coordinator
U.S. Environmental Protection Agency
Region V
230 S Dearborn Street
Chicago, Illinois 60604

Re: Johns-Manville Waukegan Disposal Area RI/FS

Dear Mr. Gaither:

Enclosed for your review is a copy of the report prepared for Johns-Manville outlining the details of the studies of common inorganic anions in surface and ground water and lead in the ambient air.

These studies were conducted as outlined in KMA's June 24, 1985 (Revised July 3, 1985) letter. These studies show that the common inorganic anion concentrations in the ground and surface waters, in the vicinity of the disposal area are less than the drinking water quality standards and the ground water movement direction indicated by the observed inorganic anion concentrations is generally northward and then eastward to Lake Michigan.

The observed lead concentrations in the air in the vicinity of the disposal area are at least one order of magnitude smaller than the National Ambient Air Quality Standard of 1.5 ug/m^3 . Also the observed Total Suspended Particulates (TSP) values in the air in the vicinity of the disposal area are less than the National Ambient Air Quality Standard value of 260 ug/m^3 .

I hope this information will be of further assistance to you in your "Final RI Report" review. Please feel free to contact me if you have questions on any of the information included in this technical memorandum.

Sincerely yours,

S. K. Malhotra, Ph.D., P.E.

cc: James H. Whipple, P.E.

SKM:sa

TABLE OF CONTENTS

	Page
1.0 INTRODUCTION	1
2.0 EVALUATION OF COMMON INORGANIC ANIONS IN SURFACE AND GROUND WATER	2
2.1 Objectives	2
2.2 Surface and ground water sampling	2
2.3 Estimated direction of ground water movement using anion data	4
2.4 Discussion of results	8
3.0 AMBIENT AIR QUALITY MONITORING	12
3.1 Objectives	12
3.2 Air sampling and analysis	12
3.2.1 Executive Summary	12
3.2.2 Discussion of results and risk assessment	14
4.0 CLAYTON ENVIRONMENTAL CONSULTANTS AMBIENT AIR QUALITY MONITORING REPORT	

LIST OF TABLES AND FIGURES

Tables

Page

Table M-2-1

Summary of field measurements of ground and surface waters

5

Table M-2 -2

Common inorganic anions in ground and surface waters (April, 1985)

6

Table M-2-3

Common inorganic anions in ground and surface waters (July, 1985)

7

Figures

Figure M-2-1

Monitoring well/surface water sampling location map

3

Figure M-2-2

Iso-concentration contour map (Specific Conductance) July, 1985

9

Figure M-2-3

Iso-concentration contour map (Bicarbonate-alkalinity) July, 1985

10

Figure M-2-4

Iso-thermal contour map (July, 1985)

11

APPENDICES

PAGE

APPENDIX M-2-A

Scope of additional site investigation in response to
draft RI Report Review Comments

A-1 to A-4

APPENDIX M-2-B

- . Common inorganic anions in ground and
surface waters
- . April 20, 1973 Ground water sample analysis
in the vicinity of Johns-Manville Disposal
Area

B-1 to B-3

B-4

APPENDIX M-2-C

Related air quality monitoring data for lead
and TSP from IEPA

C-1 to C-8

1.0 INTRODUCTION

The monitoring of ambient air for lead, and of surface and ground water in the vicinity of the disposal area for common inorganic anions, were undertaken in response to some of the USEPA review comments on the draft RI report. A letter dated July 3, 1985 to Mr. Rodney Gaither of USEPA included responses to draft RI report review comments and an outline of the inorganic anion and lead evaluations. A copy of this letter outlining the scope of these evaluations is presented in Appendix M-2-A and the details of these evaluations along with a summary of the results are presented in this technical memorandum.

2.0 EVALUATION OF COMMON INORGANIC ANIONS IN SURFACE AND GROUNDWATER

This section presents details of common inorganic anion evaluations .

2.1 Objective:

The following are objectives of this study:

- . To obtain more data on the inorganic anions to judge the drinking water quality of the surface and ground water in the vicinity of the disposal area.
- . To obtain additional information on the groundwater movement in the vicinity of the disposal area to supplement information presented in the RI report which was obtained through the use of ground water temperature and elevation data.

2.2 Surface and Ground Water Sampling and Analysis:

Groundwater samples were collected from the existing five monitoring wells constructed for the remedial investigations. In addition, surface water samples were collected from Lake Michigan and the industrial canal which receives the bulk of the recycle water from the process water settling basins located on the disposal area. The ground water monitoring wells and surface water sampling locations are shown in figure M-2-1. These were as follows:

- . Monitoring wells # 1 thru 5 (samples 1 thru 5)
- . Lake Michigan, using Waukegan city water intake (City Raw Tap or Waukegan Plant intake)
- . Industrial Canal* near the head end of the canal (Industrial Canal)
- . Lake Michigan Shore, east of MW #4 (east of well #4 or N-Lake)
- . Lake Michigan shore, east of monitoring wells #2 (East of well #2 or C-Lake)
- . Lake Michigan shore, north of Commonwealth Edison discharge (North of Commonwealth Edison discharge or S-Lake)

* Industrial Canal

FIGURE M-2-1
MONITORING WELL/SURFACE WATER
SAMPLING LOCATION MAP

JOHNS-MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS
S94-3224

Kumar Malhotra & Assoc., Inc. — Grand Rapids, Michigan

LEGEND

— Flow Direction of
Surface System

Well Number
Monitoring Well
Surface Water
Sample Locations
Filtering
Berm

(Scale Approx.)

Adapted From Johns-Manville
Map Date 2-8-84

Reference Point
10,000N & 10,000E

Manville Property
Line Fence

Borrow Pit

Pumping Lagoons

Flexboard
Effluent

Waste Pile

Mixing
Basin

Settling Basin

Collection
Basin

Waste Pile

Paper Mill
Effluent

Sewer

Asphalt
Disposal Pit

Misc.
Disposal Pit

Parking

Employee

Illinois Beach State Park

Industrial Canal

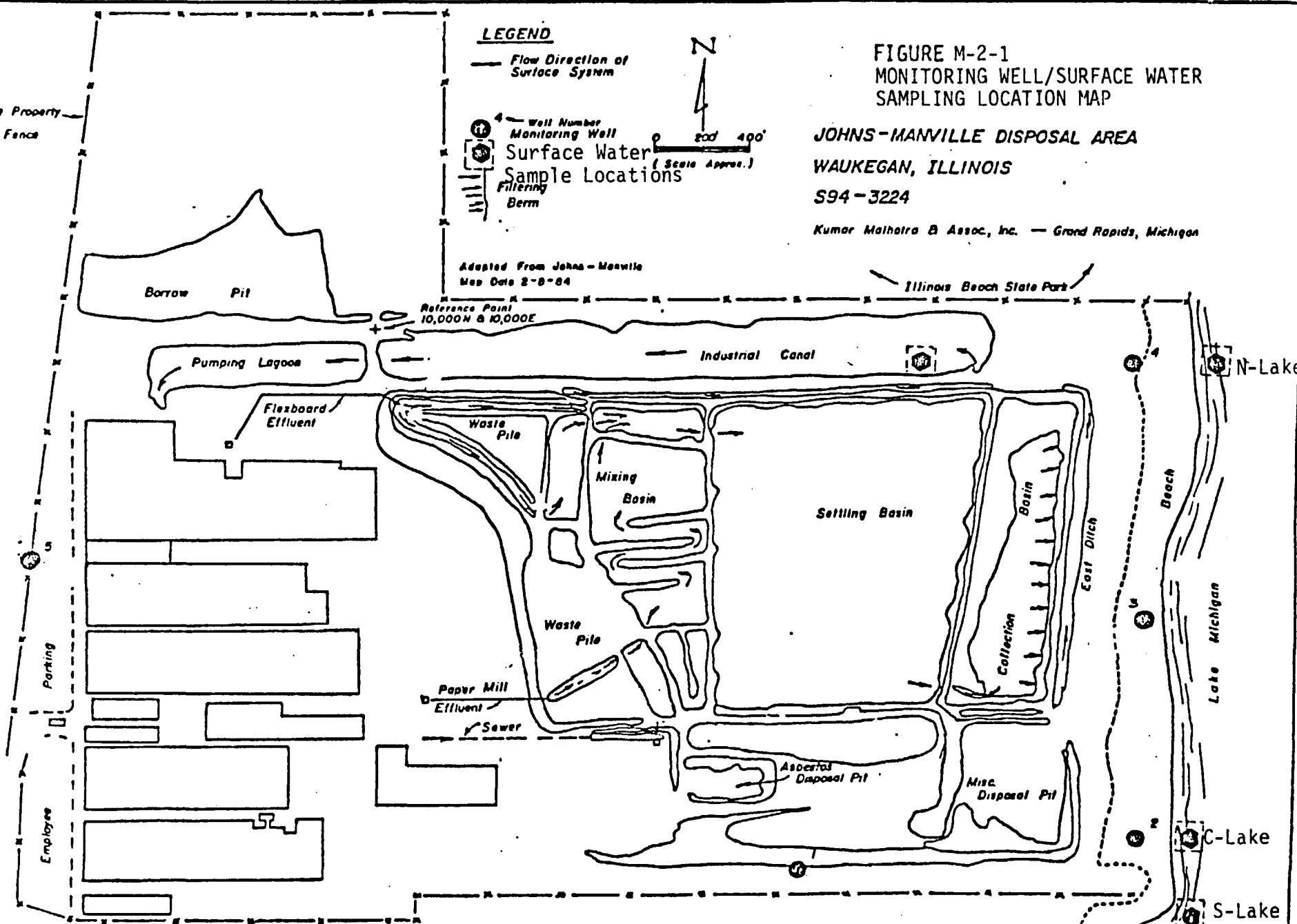
Beach

Lake Michigan

N-Lake

C-Lake

S-Lake



analysis during second set of sampling only.

Two sets of samples were used. One set was the duplicate samples collected on April 29 and April 30, 1985. These samples were stored at room temperature until their analysis in the last week of June, 1985. A second set of samples was collected on July 31, 1985.

These were preserved and delivered for common inorganic anion analysis. All samples were analyzed by Prein & Newhof Laboratory, Grand Rapids, Michigan using the USEPA approved procedures.

Only monitoring well water elevation data was obtained during the first set of sampling. However, during the second set of sampling the following field data was collected:

- . Monitoring well water elevation
- . Field pH, specific conductance and temperature of surface and monitoring well samples.

The field data for the two sets of sampling is summarized in Table M-2-1.

All water samples collected were analyzed for pH, specific conductance, chlorides, sulfates, nitrate-nitrogen, total-alkalinity, bicarbonate-alkalinity and carbonate-alkalinity. The results obtained are presented in Tables M-2-2 and M-2-3 and Appendix M-2-B.

2.3 Estimated Directions of Ground Water Movement Using Inorganic Anion and Field Temperature Data

Data for specific conductance, and biocarbonate alkalinity was selected as representative of common inorganic anions for obtaining ground water iso-concentration lines (contours). Since field specific conductance and laboratory conductance values are consistent with each other, laboratory specific conductance data was

TABLE M-2-1 SUMMARY OF FIELD MEASUREMENTS OF GROUND AND SURFACE WATERS
(JOHNS-MANVILLE DISPOSAL AREA - APRIL 29 & 30, 1985 AND JULY 31, 1985)

Sample Location	Static Water Elevation (Ft above mean sea level (April, 1985))	(JULY, 1985)		Specific Conductance umhos/cm	Temperature oC
	Static Water Elevation (Ft above mean sea level)	pH			
M well #1	585.11	584.72	7.30	972	17.8
#2	583.21	584.11	7.20	880	15.7
#3	583.31	584.30	7.10	612	16.0
#4	583.48	583.69	7.40	585	14.6
#5	583.49	583.56	6.82	810	15.9
City Raw Tap	--	--	7.07	241	15.7
Industrial Canal	--	--	7.75	525	22.1
C-Lake (East of M-W #2)	--	--	7.20	260	19.8
N-Lake (East of M-W #4)	--	--	7.80	253	20.3
S-Lake (SE of M-W #2)	--	--	8.29	250	19.5

TABLE M-2-2 COMMON INORGANIC ANIONS IN GROUND AND SURFACE WATERS

(JOHNS-MANVILLE SAMPLES COLLECTED 4/29 & 30, 1985
AND RECEIVED FOR ANALYSIS ON 6/24/1985)

Sample Location	Specific Conductance umhos/cm	Chloride mg/L	Sulfate mg/L	Nitrate mg/L as N	Total Alkalinity, mg/L as Ca CO ₃	Bicarbonate, mg/L as HCO ₃ ⁻	Carbonate, mg/L as CO ₃ ⁼
1.	1,330	116	113	2.26	591	555	0
2.	1,030	95	2	0.78	470	297	0
3.	700	75	39	0.87	233	142	0
4.	640	75	37	0.77	197	120	0
4A	610	69	38	0.47	166	101	0
5.	950	147	25	3.89	327	199	0
Water Plant Intake	290	11	21	0.59	134	82	0
East of Well #2 Lake Shore,	300	11	22	0.16	112	68	0
East of Well #4,	303	12	23	0.39	139	85	0
50' N of Commonwealth Edison Discharge	293	11	23	0.36	134	82	0

TABLE M-2-3 COMMON INORGANIC ANIONS IN GROUND AND SURFACE WATERS
(JOHNS-MANVILLE SAMPLES RECEIVED 7/31/85)

Sample Location	Specific Conductance umhos/cm	pH	Chloride mg/L	Sulfate mg/L	Nitrate mg/L as N	Total Alkalinity,mg/L as Ca CO ₃	Bicarbonate ₃ mg/L as HCO ₃ ⁻	Carbonate ₃ mg/L as CO ₃ ⁻
1.	1,350	7.3	98	15	0.65	555	339	0
2.	1,210	7.1	82	2	0.01	587	297	0
3.	825	7.2	74	30	0.17	239	146	0
4.	825	7.5	76	31	0.01	194	118	0
5.	1,140	6.8	98	6	0.01	361	220	0
City Raw Tap	363	7.7	18	24	0.12	117	71	0
Ind.-Canal	725	8.2	66	146	0.01	113	69	0
C. Lake	360	7.9	9	24	0.13	113	69	0
N. Lake	360	7.9	9	26	0.09	113	69	0
S. Lake	350	7.7	9	24	0.11	113	69	0

NOTE: Samples 1 thru 5 represent Monitoring Wells # 1 thru 5 respectively.

C - Central Shore Line, East of Monitoring Well #2

N - Northern Shore Line, East of Monitoring Well #4

S - Southern Shore Line, Southeast of Monitoring Well #2 or North of Commonwealth Edison Discharge

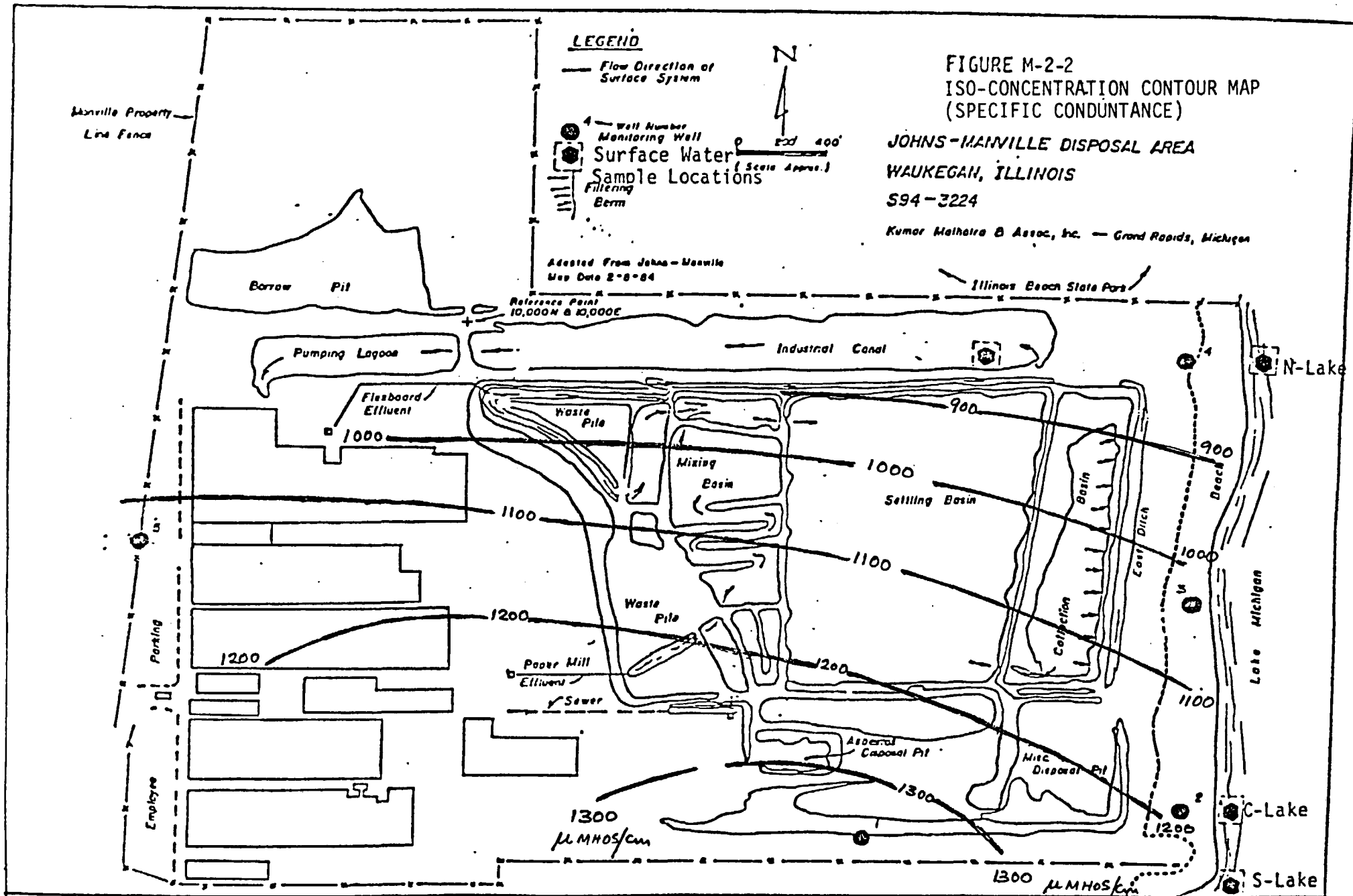
selected for preparing ground water iso-concentration contours. Since April, 1985 sample analysis data and July, 1985 analysis data on common inorganic anions are consistent with each other, data from the most recent sampling (July, 1985) was selected for iso-concentration maps presented in Figures M-2-2 and M-2-3. In addition, field temperature data was used to prepare map of iso-thermal lines (contours) presented in Figure M-2-4. These maps show that the ground water is moving generally northward and then eastward to Lake Michigan

2.4 Discussion of Results

The data from the two sets of samples show good consistency among the values for different inorganic anions and show that the ground and surface waters in the vicinity of the disposal area meet the drinking water quality standards. In addition, the observed concentrations of chlorides, nitrate-nitrogen and total-alkalinity in the ground water are in the same range as observed in a well sample on April 20, 1973 by Illinois State Water Survey.

This well was located Southwest of Commonwealth Edison power plant property and a copy of the analysis of water sample from this well is enclosed in Appendix M-2-B. This comparison further shows that the disposal area is not having any adverse impact on the common inorganic anion quality of the ground water.

The ground water movement indicated by the iso-concentration contour maps of common inorganic anions and iso-thermal contour map of field ground water temperatures is generally northward and then eastward to Lake Michigan. These findings thus confirm the general ground water movement pattern presented in the RI report obtained from the use of ground water elevation and temperature data.



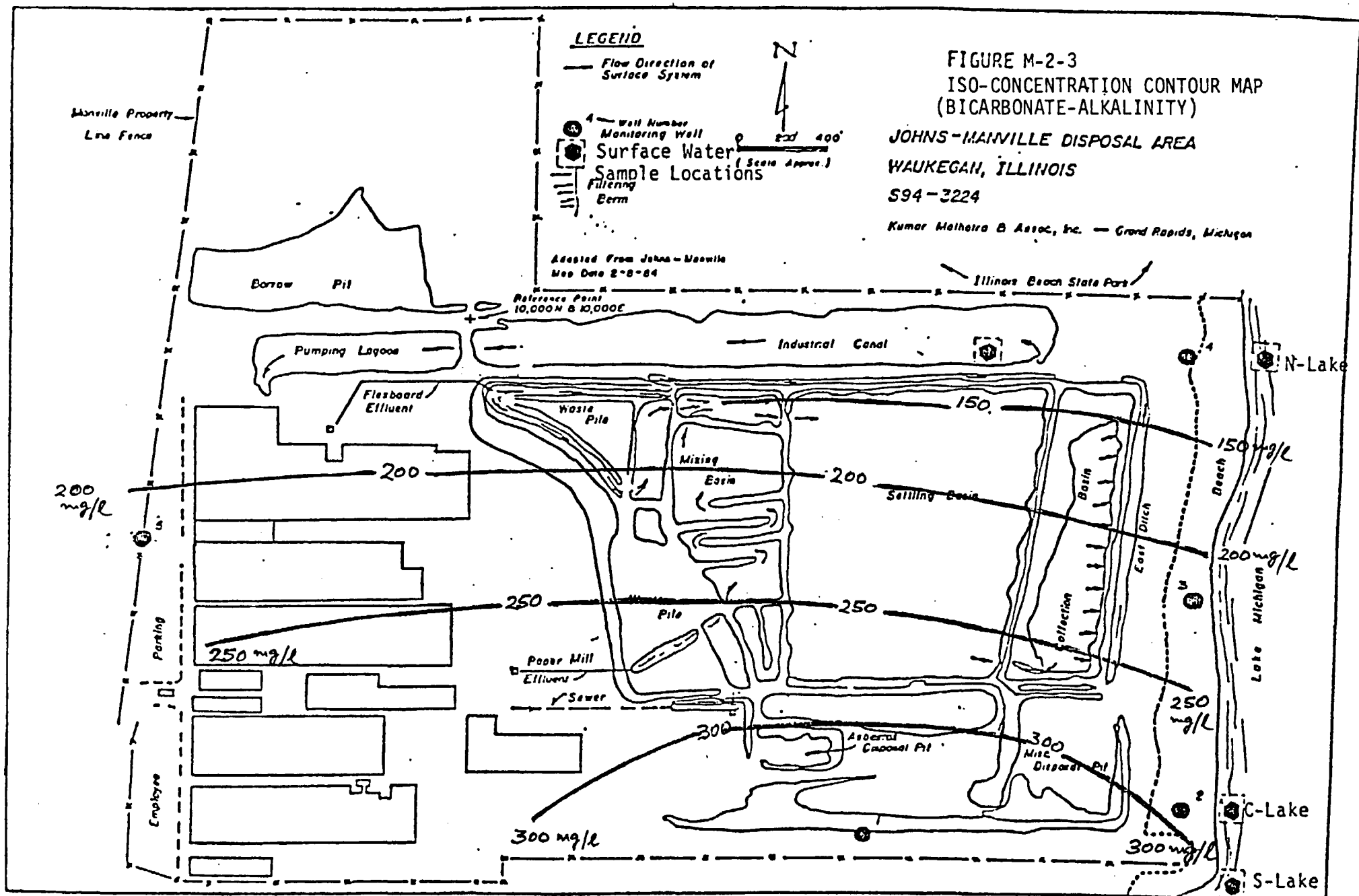
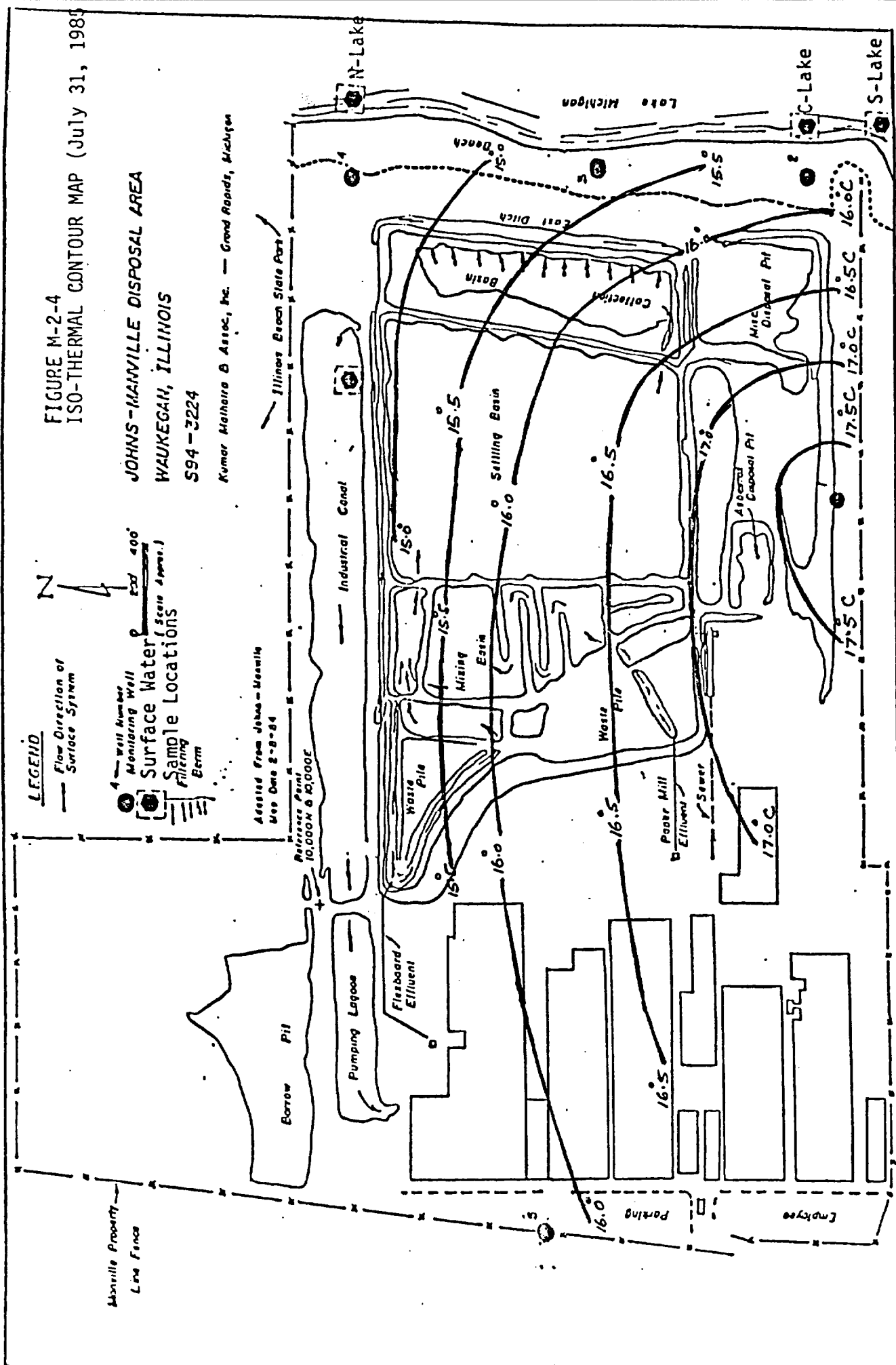


FIGURE M-2-4
ISO-THERMAL CONTOUR MAP (July 31, 1985)

JOHNS - MAINVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS
S94 - 3224

Kumar Malhotra & Assoc, Inc. — Grand Rapids, Michigan



3. AMBIENT AIR QUALITY MONITORING

This section presents details of ambient air quality monitoring for lead and total suspended particulates (TSP) in the vicinity of the disposal area.

3.1 Objectives:

The following are objectives of this study:

- . To obtain lead levels in the ambient air in the vicinity of the disposal area to assess whether lead is released from the disposal area to the atmosphere and whether any potential risk to human health and environment exists due to exposure through air.
- . To ascertain if the TSP levels in the vicinity of the disposal area are within the National Ambient Air Quality Standards (NAAQS)

3.2 Air Sampling and Analysis

Air sampling and analysis was conducted by Clayton Environmental Consultants Inc. of Southfield, Michigan. A report containing the details of sampling and analysis procedures, observed results of on-site and off-site air samples and quality assurance analysis was prepared in August, 1985. An executive summary of this study and discussion of the results with respect to study objectives are presented in this section. The detailed report is presented in the following section. (Section 4.0).

3.2.1 Executive Summary

Air was monitored at seven on-site and three off-site locations on three different days during the first week of August, 1985. Each test run was generally for a period of 24 ± 1 hours

using high volume samplers and standard 8" x 10" filters.

During some test runs some of the locations were sampled for less than 24-hour periods due to unanticipated equipment/mechanical failures. A test run was repeated if there was a precipitation of 0.10 inches or greater during the 24-hour test run. Since leaded gasoline was used in the portable generators used to operate air samplers, one of the off-site locations was chosen in a secluded wooded area located on the northwest corner of Johns-Manville property. This sampler was intended to serve as "Control" to account for the lead contribution, if any, to the samples from locations where leaded gasoline generators were used.

The filters were analysed for total suspended particulates (TSP) and lead, using USEPA recommended procedures. Field and laboratory blank filters as well as spike recovery analysis were included for quality control.

The observed values for lead were generally very low and therefore observed values from samplers operated by leaded gasoline generators were not adjusted based on the "Control" sampler values.

All on-site observed values were less than 0.08 ug/m^3 . The highest observed value of 0.107 ug/m^3 of lead was at an off-site location. This value is one order of magnitude smaller than the National Ambient Air Quality Standard (NAAQS) of 1.5 ug/m^3 .

The observed TSP values ranged between 7.2 ug/m^3 and 104.0 ug/m^3 . The highest value was observed at Location #1.

All TSP values were less than 24-hour maximum values of 260 ug/m^3 (Primary NAAQS), and 150 ug/m^3 (Secondary NAAQS). All TSP values, except at monitoring location number 1, were below the NAAQS Annual Geometric Mean Standard of 75 ug/m^3 (Primary) and 60 ug/m^3 (Secondary). Air sampler at location number 1 was about 12 feet from the unpaved road and is likely showing effects of road dust.

3.2.2 Discussion of Results and Risk Assessment

Lead: Division of air pollution control, Illinois Environmental Protection Agency (IEPA) was contacted to obtain background data. The most recent available data on lead in ambient air in Waukegan and its vicinity was collected in 1980. These values varied between 0.13 and 0.35 ug/m^3 and are presented in Appendix M-2-C. Although no data was collected on lead in Lake County in 1984, extensive amount of lead data was collected from the adjoining Cook County. This data is presented in Appendix M-2-C. The annual mean lead values in Cook County varied between 0.12 ug/m^3 to 0.52 ug/m^3 and the majority of the observed lead values were between 0.20 to 0.30 ug/m^3 .

All of the observed lead values in on-site samples from Johns-Manville disposal area were less than 0.08 ug/m^3 . These are significantly lower than those observed by Division of Air Pollution Control, Illinois EPA in the residential and commercial areas of Lake and Cook Counties. Therefore the Johns-Manville disposal area does not appear to be releasing lead to the atmosphere and hence does not pose a threat to the human health or environment in the vicinity of

the disposal area.

TSP:

The observed TSP values from the two monitoring stations in the Waukegan area, obtained during 1984 by Division of Air Pollution Control, IEPA are presented in Appendix M-2-C. The highest observed TSP values for these monitoring stations were 123 and 118 ug/m^3 respectively. The highest observed TSP value on Johns-Manville disposal area was at Station #1 and was 103 ug/m^3 . This is less than 24-hour maximum value of 150 ug/m^3 (Secondary NAAQS) and those observed during 1984 by IEPA in the residential and commercial areas of Waukegan. Thus the Johns-Manville disposal area does not exhibit any adverse impact on human health or environment from air borne suspended particulates.

SECTION 4.0

Clayton Environmental Consultants, Inc.

25711 Southfield Road, Southfield, Michigan 48075, Telephone (313) 424-8860

Ambient Air Quality Survey
for
Johns-Manville Company
Waukegan, Illinois
conducted on
August 2 - August 6, 1985

Clayton Job No. 27335-13

August 26, 1985

Clayton Environmental Consultants, Inc.

25711 Southfield Road, Southfield, Michigan 48075, Telephone (313) 424-8860

August 26, 1985

Dr. S.K. Malhotra
KUMAR MALHOTRA & ASSOCIATES
3000 East Belt Line, N.E.
Grand Rapids, MI 49505

Clayton Job No. 27735-13

Dear Dr. Malhotra:

We are pleased to present two copies of our report titled, "Ambient Air Quality Monitoring at Johns-Manville Company, Waukegan, Illinois."

It has been a pleasure working with you on this project. If you have any questions, please call.

Sincerely,



Frederick I. Cooper
Assistant Vice President
Manager, Air Quality Services

FIC/cas

Enclosures

Contents

	<u>Page</u>
1.0 <u>INTRODUCTION</u>	1
2.0 <u>PRESENTATION OF RESULTS</u>	1
3.0 <u>SAMPLING & ANALYTICAL PROCEDURES</u>	1
3.1 <u>TOTAL SUSPENDED PARTICULATES</u>	1
3.2 <u>LEAD</u>	2
3.3 <u>METEOROLOGICAL DATA</u>	2
4.0 <u>RELEVANT AIR QUALITY STANDARDS</u>	2
5.0 <u>CONCLUSION</u>	3
6.0 <u>ADDITIONAL COMMENTS</u>	4
<u>Figures</u>	
1 Sample Locations On-Site	7
2 Sample Locations Off-Site	8
 <u>Tables</u>	
1 Total Suspended Particulate Concentrations	9
2 Lead Concentrations	10
 <u>Appendices</u>	
A Hi-Vol Sampler Field Data Sheets	A-1 to A-30
B Field Data Summary Sheets	B-1 to B-3
C Meteorological Data Summary	C-1 to C-3
D USEPA RECOMMENDED SAMPLING AND ANALYSIS PROCEDURES	D-1 to D-17

Ambient Air Quality Survey
for
Johns-Manville Company
Waukegan, Illinois
conducted on
August 2 - August 6, 1985

Clayton Job No. 27735-13

Clayton Environmental Consultants, Inc.

25711 Southfield Road, Southfield, Michigan 48075, Telephone (313) 424-8860

1.0 INTRODUCTION

Kumar Malhotra & Associates, Inc. retained Clayton Environmental Consultants, Inc. to conduct an ambient air quality survey for the Johns-Manville Company at its Waukegan, Illinois location. The purpose of this study was to determine the concentrations of lead and total suspended particulate (TSP) at seven locations in the dump site and two off-site locations. See Figures 1 and 2.

Generators were used at five of the sites to provide power for the Hi-Vol samples. In order to account for the effect of lead produced from the gasoline in the generators, Site 10 was established at a remote corner of the dump site.

Mr. Ravi Vangipuram, Mr. Wesley F. Priem and Mr. John Zvetan of Clayton conducted the study on July 29 through August 7, 1985.

2.0 PRESENTATION OF RESULTS

Results of the analysis of TSP and lead are presented in Tables 1 and 2, respectively. The concentrations are expressed in micrograms per cubic meter.

3.0 SAMPLING AND ANALYTICAL PROCEDURES

3.1 TOTAL SUSPENDED PARTICULATES

TSP was collected on an 8" x 10" IPM 2000 spectrograde filter using a high volume sampler. The Hi-Vol sampler draws air at a flow rate of approximately 50 cubic feet per minute. The Hi-Vol samplers were calibrated and operated in accordance with the procedures outlined in the Environmental Protection Agency Regulating on

National Primary and Secondary Ambient Air Quality Standards, Appendix B. Each filter was tared prior to sampling and was weighed after sampling for 24 + 1 hour. Calculations were performed in accordance with the EPA regulations. See Appendices A and B.

3.2 LEAD

Ambient air lead concentrations were determined from analysis of a section of the 8" x 10" filter. Procedures followed those outlined in the EPA regulations on National Primary and Secondary Ambient Air Quality standards, Appendix G. This method involves extraction of lead from the filter with nitric acid and analysis of the extract using atomic absorption spectrophotometry (AAS).

3.3 METEOROLOGICAL DATA

Wind speed, wind direction, ambient temperature and barometric pressure data were noted at each site at least three times during each sampling run, using a portable anemometer wind vane and barometer. However, there were no significant changes in the data between sites. The meteorological data is presented in Appendix C.

If there was a precipitation of 0.1 inches or greater during any test run, that test run was repeated after 24 hours.

4.0 RELEVANT AIR QUALITY STANDARDS

The EPA regulations on National Primary and Secondary Ambient Air Quality Standards set the following maximum limits on TSP and Lead.

Total Suspended Particulates

	<u>24-hour maximum (not to exceed once a year)</u>	<u>Annual geometric mean</u>
Primary Standard	260 ug/m ³	75 ug/m ³
Secondary Standard	150 ug/m ³	60 ug/m ³

Lead

	<u>24-hour maximum</u>	<u>3-month average</u>
Primary Standard	—	1.5 ug/m ³
Secondary Standard	—	1.5 ug/m ³

The results of our tests show that the TSP and lead concentrations are well below the EPA standards at all the sampling locations.

5.0 CONCLUSION

- (1) The concentration of TSP was greater than 60 ug/m^3 during two of the three days of testing at Site 1. This is possibly because of its proximity to the road situated about 12 feet from the sampler. The concentration of TSP at most of the other sites were well below 60 ug/m^3 .
- (2) Generators were placed south of the samplers at the five sampling locations. Since southerly winds were very infrequent the contribution of lead from generators was negligible.
- (3) The concentration of lead at all the nine sampling locations were much lower than the 1.5 ug/m^3 standard.
- (4) No corrections were made for lead concentrations due to the contribution from the generators. All the lead concentrations were much lower than 1.5 ug/m^3 . The concentrations at sites with generator-driven samplers were not generally greater than concentrations at sites without generators.

This report submitted by:

V. N. Ravindran
Ravindran N. Vangipuram
Project Leader

This report approved by:

Frederick I. Cooper
Frederick I. Cooper
Assistant Vice President
Manager, Air Quality Services

August 26, 1985

6.0 ADDITIONAL COMMENTS

Sampler Locations: All samplers were located as proposed in the letter dated June 24, 1985 (revised July 3, 1985) except the two stations which were proposed on the beach. These two stations were moved west of the proposed beach locations to avoid potential vandalism/tampering of sampling equipment by public. In addition, one station was added on the Northeast corner of the Northwest 40 acre wooded area of the Johns-Manville property. As discussed earlier this station was added to serve as "Control" sampling station to account for potential lead contribution from the leaded gasoline generators used at some of the sampling locations.

Sampling and Analysis Procedures

As discussed earlier USEPA prescribed procedures for Ambient Air Quality Monitoring were used. A copy of these for TSP and lead are enclosed in Appendix D.

Sampling Periods and Meteorological Conditions

Three test runs, each for a period of 24 \pm hours were conducted as discussed earlier. The data on temperature, barometric pressure, wind speed and wind direction taken during each test run on each sampling station is presented in field data sheets included in Appendix A. A summary of the average meteorological data for the 10 stations during each of the three test runs is presented in Appendix C. No rainfall data is included with the meteorological data as it was not available from the National Climatic Data Center, Ashville, North Carolina. Precipitation data for Waukegan area obtained from National Climatic Data Center by telephone (Sam McOwen (704) 259-0682) for each test run is presented below:

Test Run #1

Duration: 8:00 A.M. August 1, 85 to 8:00 A.M. August 2, 85
(Thursday) (Friday)

Precipitation data: Recorded precipitation during this period was 0 inches.

Test Run #2

Duration: 8:00 A.M. August 2, 85 to 8:00 A.M. August 3, 85
(Friday) (Saturday)

Precipitation data: Recorded precipitation during this period was 0 inches.

Test Run #3

Duration: 8:00 A.M. August 5, 85 to 8:00 A.M. August 6, 85
(Monday) (Tuesday)

Precipitation data: Recorded precipitation from 6:00 A.M. August 5, 85 to 6:00 A.M. August 6, 85 by National Climatic Data Center is 0.20 inches. However, no rainfall of any significance was observed in the air sampling area during this sampling period or in the vicinity of the Johns-Manville disposal area. This discrepancy in the precipitation data is more likely due to the localized precipitation around the National Climatic Data Center's precipitation recording station. WKRS Radio Station is the official precipitation recording station for National Climatic Data Center and WKRS and Johns-Manville disposal area are located on the Westerly and Easterly edges of Waukegan City respectively. In general, the month of July, 1985 was relatively drier than the average July month in the Waukegan area.

Quality Control Area

The laboratory detection limit for lead per filter was 0.02 mg and the accuracy of lead measurement from the filter was $\pm 10\%$.

One field blank filter was analyzed for each test run and the lead and TSP values obtained are as follows:

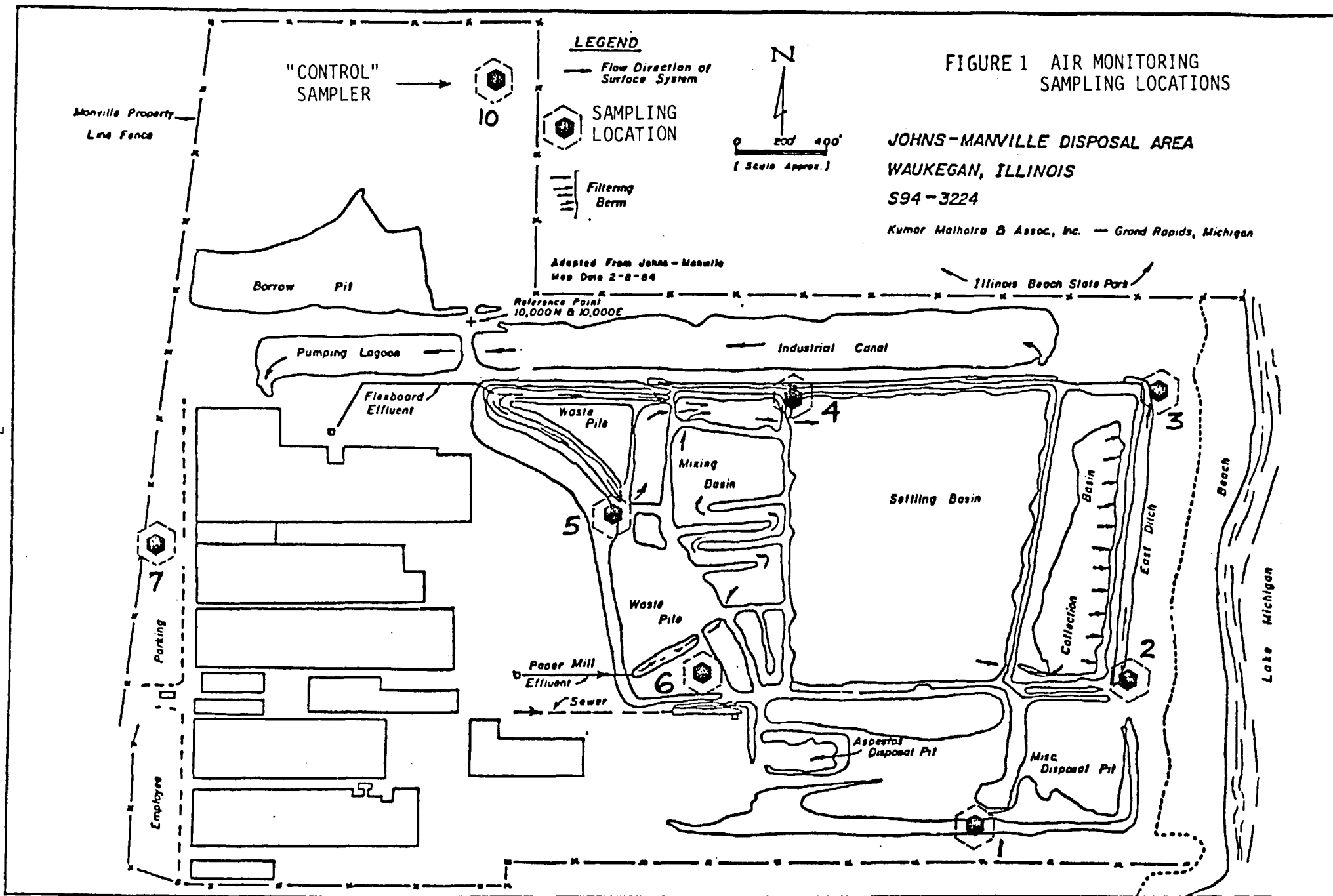
<u>Test Run Period</u>	<u>August 1-2</u>	<u>August 2-3</u>	<u>August 5-6</u>
Lead (mg)	0.02	.02	.02
TSP (mg)	-0.5	-0.8	-1.0

In addition four filters were spiked by 0.20 mg of lead. The percent recovery data for these is as follows:

<u>Sample</u>	<u>Percent Recovery</u>	<u>Average Recovery</u>
1	48	
2	62	
3	64	56%
4	50	

Full filter was used for each lead analysis and the average recovery of 56% was used to calculate the actual lead on the filter.

-7-



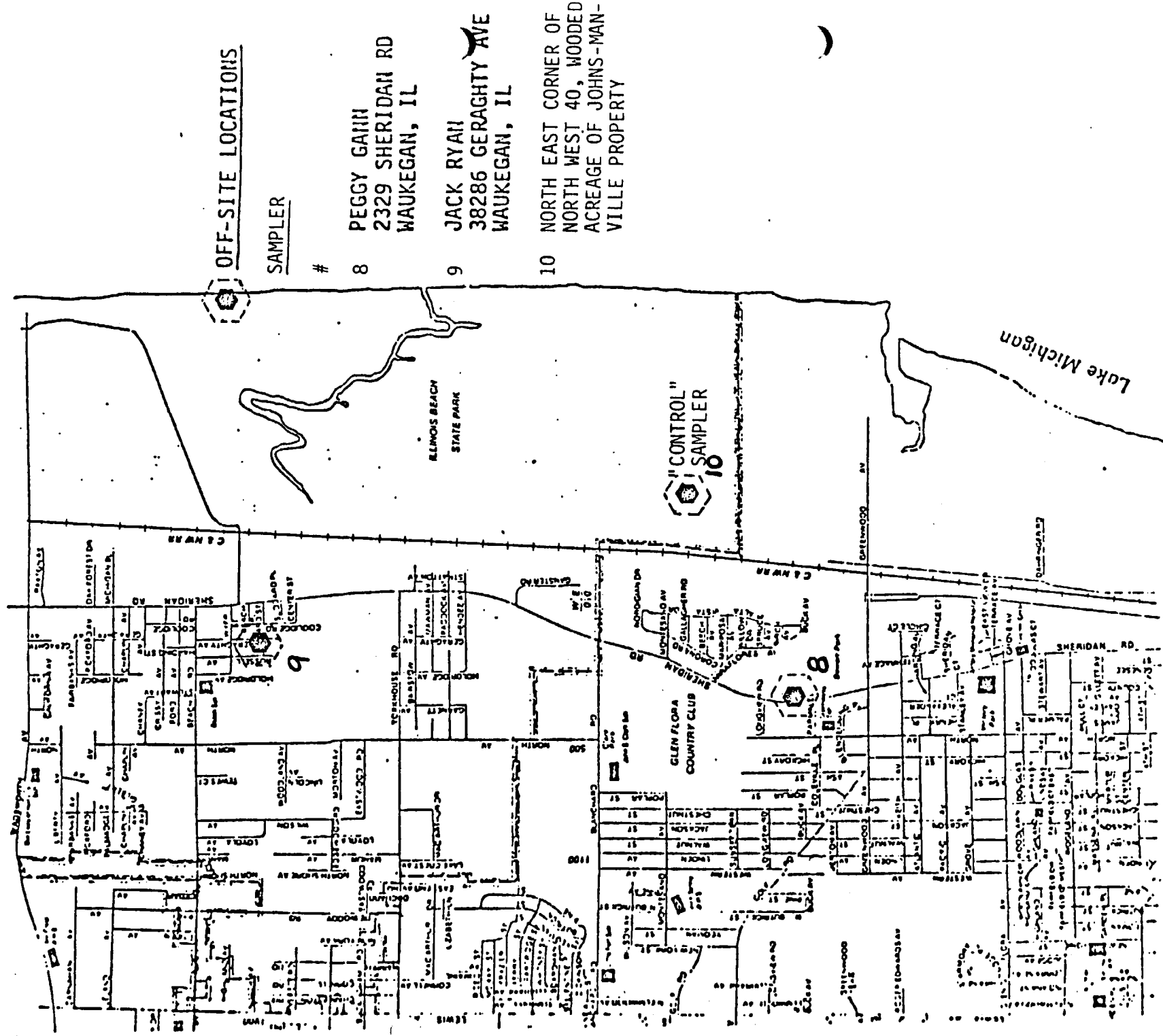


Figure 2 Locations of Off-Site Samplers.

TABLE 1

TSP Concentrations (ug/m³)
Johns-Manville Company
Waukegan, Illinois

Site Number	Sampling Date		
	August 1-2, 1985	August 2-3, 1985	August 5-6, 1985
1 *	55.7	104.0	65.4
2 *	11.4	23.6	40.0
3 *	8.0	15.6	28.8
4 *	7.2	12.5	21.1
5 *	12.5	26.00	37.3
6	11.1	32.8	35.8
7	30.8	64.0	32.3
8	16.6	23.4	27.7
9	12.7	36.9	23.4
10 *	9.7	19.6	30.8

*Indicates samplers with generators

TABLE 2

Lead Concentrations (ug/m³)
Johns-Manville Company
Waukegan, Illinois

Site Number	Sampling Date		
	August 1-2, 1985	August 2-3, 1985	August 5-6, 1985
1 *	0.0123	0.0497	0.0229
2 *	0.0062	0.0556	0.0361
3 *	0.0060	0.0426	0.0203
4 *	0.0060	0.0371	0.0226
5 *	0.0090	0.0206	0.0434
6	0.0060	0.0400	0.0212
7	0.0140	0.0778	0.0090
8	0.0530	0.1070	0.0450
9	0.0130	0.0449	0.0100
10 *	0.0110	0.0298	0.0115

*Indicates samplers with generators

APPENDIX A
HI-VOL SAMPLER FIELD DATA SHEETS

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

HI-VOL DATA RECORD
(Continued)

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: _____

time OP gas filled T P

8:10

8 16

(4.5-1.1)

11:35

15:02

19:50

00:20

04:13

(4.5-1.1)

11:32

12:00

14:50

16:20

5.1

4

2.5

3

N

N

✓

✓

✓

✓

✓

✓

72

68

67

66

65

2334

2881

2881

28.12

28.82

28.9

STATION LOCATION John ManvilleCITY & STATE WaukeganSITE ADDRESS MalhotraPROJECT Malhotra SITE NO. 1

INSTRUMENT LAST CALIBRATED _____

MOTOR IDENTIFICATION NO. 21

ROTAMETER IDENTIFICATION NO. _____

FILTER NUMBER 5166922START SAMPLING 08 1 85 8 16
mo day yr hr min CFMSTOP SAMPLING 08 2 85 8 31
mo day yr hr min CFMELAPSED TIME METER READING 9603 11054
Initial Final

WIND: _____ calm, _____ light, _____ gusty

VISIBILITY: _____ clear, _____ hazy

SKY: _____ clear, _____ scattering

_____ overcast

HUMIDITY: _____ dry, _____ moderate

_____ humid

TEMPERATURE °F: _____ <20, _____ 20-40,

_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight

- Flowrate must be ± 10% of established flowrate

- Faceplate gasket must be in good condition

- Rotameter must be free of foreign material

- Rotameter operation must be stable

- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines

Signature

REMARKS: Total sampling time: 14 min

_____ +15 min

_____ 1455

_____ 1446 Time

HI-VOL DATA RECORD
(Continued)

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: _____

t	DP	gas filled	T	P
8:23	1.5	✓	28	31
1:42			31	34
15:10		✓	65	31
20:00		✓		28 32
21:33		✓		
24:21		✓		
8:39	1.4	✓	65	28 4

8:39 calm -

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

STATION LOCATION Johns Hanville
CITY & STATE

SITE ADDRESS Waukegan

PROJECT Hallston SITE NO. 2

INSTRUMENT LAST CALIBRATED _____

MOTOR IDENTIFICATION NO. 11

ROTAMETER IDENTIFICATION NO. _____

FILTER NUMBER 5166917

START SAMPLING 8 1 85 8 23
mo day yr hr min CFM

STOP SAMPLING 8 2 85 8 35
mo day yr hr min CFM

ELAPSED TIME METER READING 41543.3 4782.3
Initial

WIND: _____ calm, _____ light, _____ gusty

VISIBILITY: _____ clear, _____

SKY: _____ clear, _____ scattering
_____ overcast

HUMIDITY: _____ dry, _____ moderate
_____ humid

TEMPERATURE °F: _____ <20, _____ 20-40,
_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight
- Flowrate must be ± 10% of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines

Signature _____

REMARKS: _____

298.7 min

HI-VOL DATA RECORD
(Continued)

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: Pump was dead at 8:52 (avg 2)
The generator was OK

t	DP	gas filled	T	P
8:55	2.45	✓		23.8
11:45			50	28.2
13:24		✓	68	28.2
14:05		✓		28.2
15:52	Dead animal	✓	65	28.7

Time	Wt	Wt
8:52	calm	-

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

STATION LOCATION Johns Hanville
CITY & STATE

SITE ADDRESS Waukegan

PROJECT Malhotra SITE NO. 3

INSTRUMENT LAST CALIBRATED _____

MOTOR IDENTIFICATION NO. 7

ROTAMETER IDENTIFICATION NO. _____

FILTER NUMBER 5166921V

START SAMPLING 8 1 85 8 35
mo day yr hr min CFM

STOP SAMPLING 8 2 85 8 52
mo day yr hr min CFM

ELAPSED TIME METER READING 8:55 %
Initial Final

WIND: _____ calm, _____ light, _____ gusty

VISIBILITY: _____ clear, _____ hazy

SKY: _____ clear, _____ scattering
_____ overcast

HUMIDITY: _____ dry, _____ moderate
_____ humid

TEMPERATURE °F: _____ <20, _____ 20-40,
_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight
- Flowrate must be + 10% of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines

Signature _____

REMARKS: Total time not
clear (SEE REMARKS)
8:52 min

HI-VOL DATA RECORD
(Continued)

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: Calibrated at 0.33 L/min

For 4 hrs. sampled

0.33 L/min

t	ΔP	gas filled	T	P
8:45	3.3	✓	28	28.9
11:07			58	28.2
13:35			63	28.2
20:15		✓		
0.33		✓		
24:31		✓		
9:01	3.3	✓	65	28.9

9:01

calm

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

STATION LOCATION Johns Manville
CITY & STATE

SITE ADDRESS Waukegan

PROJECT Malhotra SITE NO. 4

INSTRUMENT LAST CALIBRATED _____

MOTOR IDENTIFICATION NO. 1

ROTAMETER IDENTIFICATION NO. _____

FILTER NUMBER 5166920 ✓

START SAMPLING 8 1 85 8 45
mo day yr hr min CDT

STOP SAMPLING 8 2 85 9 01
mo day yr hr min CDT

ELAPSED TIME METER READING 3:15
Initial

WIND: _____ calm, _____ light, _____ gusty

VISIBILITY: _____ clear, _____

SKY: _____ clear, _____ scattering

_____ overcast

HUMIDITY: _____ dry, _____ moderate

_____ humid

TEMPERATURE °F: _____ <20, _____ 20-40,

_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight
- Flowrate must be ± 10% of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines

Signature _____

REMARKS: Flow rate 0.33 L/min

Checked for 3 hrs + 6 hrs - 1 hr

Total time: 1440 + 16 - 420 = 1030

HI-VOL DATA RECORD
(Continued)

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: _____

<u>t</u>	<u>DP</u>	<u>gas filled</u>	<u>T. P</u>
8:55	1.9	✓	28.8
11:55			30 28.2
13:30		✓	68 28.2
20:25		✓	
01:51		✓	
04:01		✓	
9:14	1.9	✓	65 28.9

T _{amb}	50.1	—
T ₂₀	50.1	50.1
9:14	Calm	—

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

STATION LOCATION Johns Manville
CITY & STATE

SITE ADDRESS Waukegan

PROJECT Malhotra SITE NO. 5

INSTRUMENT LAST CALIBRATED _____

MOTOR IDENTIFICATION NO. 3

ROTAMETER IDENTIFICATION NO. _____

FILTER NUMBER 5166713 ✓

START SAMPLING 8 1 85 8 55
mo day yr hr min CFM

STOP SAMPLING 8 2 85 9 14
mo day yr hr min CFM

ELAPSED TIME METER READING 8 55 8:11
Initial Final

WIND: _____ calm, _____ light, _____ gusty

VISIBILITY: _____ clear, _____ hazy

SKY: _____ clear, _____ scattering

_____ overcast

HUMIDITY: _____ dry, _____ moderate

_____ humid

TEMPERATURE °F: _____ <20, _____ 20-40,

_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight
- Flowrate must be ± 10% of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines

Signature _____

REMARKS: Final time 14:41 - 64 =

1596 min

HI-VOL DATA RECORD
(Continued)

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: _____

t	DP	gas filled	T	P
9:01	3.4" H ₂ O	X		28.5
12:01			80	28.82
9:20	3.6" H ₂ O		65	28.9

Time	Wind	Temp
12:01	S	56
9:20	Calm	-

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

STATION LOCATION _____
CITY & STATE Johns Manville

SITE ADDRESS Waukegan

PROJECT Malhotra SITE NO. 6

INSTRUMENT LAST CALIBRATED _____

MOTOR IDENTIFICATION NO. 25

ROTAMETER IDENTIFICATION NO. _____

FILTER NUMBER 5166723

START SAMPLING 8 1 85 9 01
mo day yr hr min CFM

STOP SAMPLING 8 2 85 9 20
mo day yr hr min CFM

ELAPSED TIME METER READING 87534 10413
Initial

WIND: _____ calm, _____ light, _____ gusty

VISIBILITY: _____ clear, _____

SKY: _____ clear, _____ scattering
_____ overcast

HUMIDITY: _____ dry, _____ moderate
_____ humid

TEMPERATURE °F: _____ <20, _____ 20-40,
_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight
- Flowrate must be ± 10% of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines

Signature _____

REMARKS: Final Run 10413-87534

- 10496

HI-VOL DATA RECORD
(Continued)

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: _____

6 DP gas filled T P
9:20 3.8 X 28.8
11:15 80 28.2

11:54
9:37 3.6 70 28.9

time ml to
12:15 5 355
9:37 calm -

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

STATION LOCATION _____
CITY & STATE Johns Manville

SITE ADDRESS Waukegan

PROJECT _____ SITE NO. 7

INSTRUMENT LAST CALIBRATED _____

MOTOR IDENTIFICATION NO. 19

ROTAMETER IDENTIFICATION NO. _____

FILTER NUMBER 51559164

START SAMPLING 8 1 85 7 20
mo day yr hr min CFM

STOP SAMPLING 8 2 88 9 37
mo day yr hr min CFM

ELAPSED TIME METER READING 8752.4 10421.4
Initial Final

WIND: _____ calm, _____ light, _____ gusty

VISIBILITY: _____ clear, _____ hazy

SKY: _____ clear, _____ scattering
_____ overcast

HUMIDITY: _____ dry, _____ moderate
_____ humid

TEMPERATURE °F: _____ <20, _____ 20-40,
_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight
- Flowrate must be \pm 10% of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines

Signature _____

REMARKS: Total run time 14:55

HI-VOL DATA RECORD
(Continued)

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: _____

<u>t</u>	<u>DP</u>	<u>gas filled</u>	<u>T</u>	<u>P</u>
8:26	3.8	X		283
12:25			55	2.5
9:45	4.1			

<u>Time</u>	<u>Wind</u>	<u>Temp</u>
12:25	5	13.5
9:45	Calm	—

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48073

STATION LOCATION CITY & STATE John Manville
SITE ADDRESS Waukegan (2329) (320)
PROJECT Hallstrom SITE NO. 8
INSTRUMENT LAST CALIBRATED _____
MOTOR IDENTIFICATION NO. 20
ROTAMETER IDENTIFICATION NO. _____
FILTER NUMBER 5166718
START SAMPLING 8 1 85 9 26
mo day yr hr min sec
STOP SAMPLING 8 2 85 9 45
mo day yr hr min sec
ELAPSED TIME METER READING 54613 10620
Initial

WIND: _____ calm, _____ light, _____ gusty
VISIBILITY: _____ clear, _____ h
SKY: _____ clear, _____ scattering
_____ overcast

HUMIDITY: _____ dry, _____ moderate
_____ humid
TEMPERATURE °F: _____ <20, _____ 20-40,
_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight
- Flowrate must be + 10% of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines

Signature _____

REMARKS: Total run time 14.5 - 7
= 14.5

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

HI-VOL DATA RECORD
(Continued)

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: _____

<u>t</u>	<u>DP</u>	<u>gas filled</u>	<u>T</u>	<u>P</u>
9:57	3.7	f	28	28.8
12:35			52	28.2
9:54	3.7		75	28.9

<u>Time</u>	<u>Wind</u>	<u>Temp</u>
12:35	5	55.0
12:38	calm	-

STATION LOCATION Johns Manville
CITY & STATE _____
SITE ADDRESS Waukegan (38286)
PROJECT Moline R.R. SITE NO. 49
INSTRUMENT LAST CALIBRATED _____
MOTOR IDENTIFICATION NO. 22
ROTAMETER IDENTIFICATION NO. _____
FILTER NUMBER 516-919
START SAMPLING 8 1 85 9 37
mo day yr hr min CFM
STOP SAMPLING 8 2 85 9 54
mo day yr hr min CFM
ELAPSED TIME METER READING 9031 10457.8
Initial Final

WIND: _____ calm, _____ light, _____ gusty
VISIBILITY: _____ clear, _____ hazy
SKY: _____ clear, _____ scattering
_____ overcast
HUMIDITY: _____ dry, _____ moderate
_____ humid

TEMPERATURE °F: _____ <20, _____ 20-40,
_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight
- Flowrate must be ± 10% of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines

Signature _____

REMARKS: 14558

HI-VOL DATA RECORD
(Continued)

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: _____

<u>t</u>	<u>OP</u>	<u>gas filled</u>	<u>I</u>	<u>P</u>
9:11	3.3	✓		28.8
12:12			90	28.2
15:53		✓	68	28.2
20:30		✓		
1:50		✓		
4:43		✓		
7:28	3.2	✓	65	28.9

<u>time</u>	<u>m/s</u>	<u>ft</u>
12:12	5	1.5
9:18	calm	-

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

STATION LOCATION Johns Manville
CITY & STATE _____
SITE ADDRESS Waukegan
PROJECT Mallotia SITE NO. 10104
INSTRUMENT LAST CALIBRATED _____
MOTOR IDENTIFICATION NO. 18
ROTAMETER IDENTIFICATION NO. _____
FILTER NUMBER 51659151
START SAMPLING 8 1 85 9:12
mo day yr hr min CFM
STOP SAMPLING 8 2 85 9:25
mo day yr hr min CFM
ELAPSED TIME METER READING 39437 10386
Initial F T

WIND: _____ calm, _____ light, _____ gusty

VISIBILITY: _____ clear, _____ h

SKY: _____ clear, _____ scattering
_____ overcast

HUMIDITY: _____ dry, _____ moderate
_____ humid

TEMPERATURE °F: _____ <20, _____ 20-40,
_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight
- Flowrate must be ± 10% of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines

Signature _____

REMARKS: Final time 14:15

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

HI-VOL DATA RECORD
(Continued)

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: _____

Time	AP	T	P	WS	WD	From
8:33 (4-2-11)		65	28.9	calm	-	✓
11:33		72	28.88	3	SW	✓
15:45		72	28.86	C-3	NNW	✓
18:58		65	28.78	calm	-	✓
20:40		66	28.83	0-2	ESE	✓
3:57		66	28.83	calm	-	✓
8:47 (4-2-11)						

STATION LOCATION
CITY & STATE 7.2 mi. MarshallSITE ADDRESS Wackerly AvePROJECT Halifax SITE NO. 1

INSTRUMENT LAST CALIBRATED _____

MOTOR IDENTIFICATION NO. 21

ROTAMETER IDENTIFICATION NO. _____

FILTER NUMBER 5166933START SAMPLING 08 2 85 8 33
mo day yr hr min CFMSTOP SAMPLING 8 3 85 8 47
mo day yr hr min CFMELAPSED TIME METER READING 11054 12449
Initial Final

WIND: _____ calm, _____ light, _____ gusty

VISIBILITY: _____ clear, _____ hazy

SKY: _____ clear, _____ scattering

_____ overcast

HUMIDITY: _____ dry, _____ moderate
_____ humidTEMPERATURE °F: _____ <20, _____ 20-40,
_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight
- Flowrate must be ± 10% of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance
with the above guidelines

Signature _____

REMARKS: 1375

HI-VOL DATA RECORD
(Continued)

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: GENERATOR NOT WORKING
@ 4:00 OUT approximately 3 1/2 hrs.
Fixed problem @ 4:30.

Time	H ₂ O DP	% T	% P	m/s WS	WD	gas filled	oil
8:46	1.5	65	28.7	calm	-	✓	
11:41		72	23.33	5	SW	✓	
15:55		72	23.86	0-5	WNW	✓	
18:55		65	28.73	calm	-	✓	
21:45						✓	
00:50						✓	
04:40		66	28.83	calm	-	✓	✓
8:42	1.5						

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

STATION LOCATION John Hamble
CITY & STATE _____

SITE ADDRESS Wacker

PROJECT Milwaukee SITE NO. 2

INSTRUMENT LAST CALIBRATED _____

MOTOR IDENTIFICATION NO. 11

ROTAMETER IDENTIFICATION NO. _____

FILTER NUMBER 5166932

START SAMPLING 8 2 85 8 46
mo day yr hr min CFM

STOP SAMPLING 8 3 85 8 42
mo day yr hr min CFM

ELAPSED TIME METER READING 428829 4401
Initial

WIND: _____ calm, _____ light, _____ gusty

VISIBILITY: _____ clear, _____

SKY: _____ clear, _____ scattering

_____ overcast

HUMIDITY: _____ dry, _____ moderate

_____ humid

TEMPERATURE °F: _____ <20, _____ 20-40,

_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight

- Flowrate must be ± 10% of established flowrate

- Faceplate gasket must be in good condition

- Rotameter must be free of foreign material

- Rotameter operation must be stable

- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines

Signature _____

REMARKS: Stopped 4:35 PM 11/15/85

Stopped at 21:45 - Started - 21:55

Total runtime 1127.2

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

HI-VOL DATA RECORD (Continued)

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: _____

STATION LOCATION Johns Manville
CITY & STATE Waukegan
SITE ADDRESS Waukegan
PROJECT Mathura SITE NO. 3
INSTRUMENT LAST CALIBRATED _____
MOTOR IDENTIFICATION NO. 4 (pump motor)
ROTAMETER IDENTIFICATION NO. 24 hr run
FILTER NUMBER 5/66931
START SAMPLING 8 2 85 8 51
mo day yr hr min CFM
STOP SAMPLING 8 3 85 8 34
mo day yr hr min CFM
ELAPSED TIME METER READING 8 57 8 50
Initial Final
WIND: _____ calm, _____ light, _____ gusty
VISIBILITY: _____ clear, _____ hazy
SKY: _____ clear, _____ scattering
_____ overcast

Time	ΔP	T	P	WS	WD	gms filtered
8:57	20	65	28.9	Calm	-	✓
11:47		72	28.82	E	SW	✓
15:57		73	28.80	SW	WAW	✓
18:52		65	28.79	Calm	-	✓
20:55						✓
04:48		66	28.83	Calm	-	✓
8:37	22					

HUMIDITY: _____ dry, _____ moderate
_____ humid
TEMPERATURE °F: _____ <20, _____ 20-40,
_____ 41-60, _____ 61-80, _____ >80
- Faceplate must be hand tight
- Flowrate must be ± 10% of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines

Signature _____

REMARKS: 1453

HI-VOL DATA RECORD
(Continued)

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

STATION LOCATION
CITY & STATE Johns Harbor

SITE ADDRESS Wachusett

PROJECT Maibara SITE NO. 4

INSTRUMENT LAST CALIBRATED _____

MOTOR IDENTIFICATION NO. 1

ROTAMETER IDENTIFICATION NO. _____

FILTER NUMBER 5166930

START SAMPLING 8 2 85 9 09
mo day yr hr min CFH

STOP SAMPLING 8 3 85 8 28
mo day yr hr min CFH

ELAPSED TIME METER READING 9.09 5.25
Initial Final

WIND: _____ calm, _____ light, _____ gust

VISIBILITY: _____ clear, _____ hazy

SKY: _____ clear, _____ scattered

_____ overcast

HUMIDITY: _____ dry, _____ moderate
_____ humid

TEMPERATURE °F: _____ <20, _____ 20-40,
_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight
- Flowrate must be ± 10% of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines

Signature X

REMARKS: Total run time 12.5

REMARKS: Gen. stopped at 4:50. No. 4
it at 7:50. [unclear] 1hr]
Generator out @ 4:50 started
it last time = 2 hrs

Time	DP	T	P	WS	WD	gas	oil
9:09	3.4	65	28.9	calm	-	✓	✓
11:05		75	28.8	3	SW	✓	✓
16:03		75	28.6	3-5	WNW	✓	✓
18:48		65	28.79	calm	-	✓	✓
11:03						✓	✓
04:54		66	28.83	calm	-	✓	✓
8:28	3.1						

HI-VOL DATA RECORD
(Continued)

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: Gen. dust at 1514 (172) e Works
OK only if no load is on.
Fixed Gen. @ 5:00. TURNED ON
HI Vol

Time	AP	T	P	WS	WD	gas
9:17	1.8	65	289	Calm	-	✓
12:02		75	2333	3	SW	✓
16:07						✓
5:00						✓
8:28	1.8					✓

gas fixed OIL

STATION LOCATION Johns Manville
CITY & STATE Waukegan
SITE ADDRESS Malhona SITE NO. 5
INSTRUMENT LAST CALIBRATED _____
MOTOR IDENTIFICATION NO. 3
ROTAMETER IDENTIFICATION NO. _____
FILTER NUMBER 5166926
START SAMPLING 8 2 55 9 17
mo day yr hr min CFM
STOP SAMPLING 8 3 55 8 23
mo day yr hr min CFM
ELAPSED TIME METER READING 9:17 4:50
Initial Final ^(see)

WIND: _____ calm, _____ light, _____ gusty
VISIBILITY: _____ clear, _____ hazy
SKY: _____ clear, _____ scattering
_____ overcast

HUMIDITY: _____ dry, _____ moderate
_____ humid
TEMPERATURE °F: _____ <20, _____ 20-40,
_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight
- Flowrate must be ± 10% of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines

Signature _____

REMARKS: 433 mll

HI-VOL DATA RECORD
(Continued)

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: _____

Time	ΔP	T	P	WS	WD
9:22	3.7	70	28.9	calm	-
12:08		75	28.33	E	SW
16:26		75	28.55	0-3	NNW
19:01		65	28.79	calm	-
5:10		66	28.83	calm	-
8:18	5.3				

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

STATION LOCATION Johns Memorial
CITY & STATE Warren, MI
SITE ADDRESS Warren, MI
PROJECT Warren SITE NO. 6
INSTRUMENT LAST CALIBRATED _____
MOTOR IDENTIFICATION NO. 25
ROTAMETER IDENTIFICATION NO. _____
FILTER NUMBER 5166914
START SAMPLING 8 3 85 9 22
mo day yr hr min CFM
STOP SAMPLING 8 3 85 8 18
mo day yr hr min CFM
ELAPSED TIME METER READING 10413 11787
Initial Final

WIND: _____ calm, _____ light, _____ gusty
VISIBILITY: _____ clear, _____ h
SKY: _____ clear, _____ scattering
_____ overcast

HUMIDITY: _____ dry, _____ moderate
_____ humid
TEMPERATURE °F: _____ <20, _____ 20-40,
_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight
- Flowrate must be ± 10% of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines

Signature _____

REMARKS: 1374

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

HI-VOL DATA RECORD
(Continued)

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: _____

Time	ΔP	T	P	WS	WD
9:38	3.6	70	28.9	calm	-
12:12		75	28.88	3	SW
16:30		75	28.86	0-3	WNW
19:09		65	28.77	calm	-
21:15		66	28.83	0-2	CSG
8:09	4.2				

STATION LOCATION John Whiteville
CITY & STATE _____
SITE ADDRESS Waukegan
PROJECT Matholtha SITE NO. 7
INSTRUMENT LAST CALIBRATED _____
MOTOR IDENTIFICATION NO. 19
ROTAMETER IDENTIFICATION NO. _____
FILTER NUMBER 5166928
START SAMPLING 8 2 85 9 38
mo day yr hr min CFM
STOP SAMPLING 8 3 85 8 07
mo day yr hr min CFM
ELAPSED TIME METER READING 10421.4 11465
Initial Final

WIND: _____ calm, _____ light, _____ gusty
VISIBILITY: _____ clear, _____ hazy
SKY: _____ clear, _____ scattering
_____ overcast
HUMIDITY: _____ dry, _____ moderate
_____ humid
TEMPERATURE °F: _____ <20, _____ 20-40,
_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight
- Flowrate must be ± 10% of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines

Signature _____

REMARKS: 13436

HI-VOL DATA RECORD
(Continued)

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ mg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: _____

Time AP T P WS WD
9 47 4.2 70 28.9 calm -
7 55 40

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

STATION LOCATION
CITY & STATE Texas Alanville
SITE ADDRESS Wagon
PROJECT Malhotra SITE NO. 8
INSTRUMENT LAST CALIBRATED _____
MOTOR IDENTIFICATION NO. 20
ROTAMETER IDENTIFICATION NO. _____
FILTER NUMBER 5166927
START SAMPLING 8 2 85 9 47
mo day yr hr min CFM
STOP SAMPLING 8 3 85 7 55
mo day yr hr min CFM
ELAPSED TIME METER READING 104207 11749
Initial Final

WIND: _____ calm, _____ light, _____ gusty

VISIBILITY: _____ clear, _____

SKY: _____ clear, _____ scattering

_____ overcast

HUMIDITY: _____ dry, _____ moderate

_____ humid

TEMPERATURE °F: _____ <20, _____ 20-40,
_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight
- Flowrate must be $\pm 10\%$ of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines

Signature _____

REMARKS: 13287

HI-VOL DATA RECORD
(Continued)

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: _____

Time	DP	T	P	WS	WD
9.57	3.7	75	28.9	calm	-

9.03 3.2

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

STATION LOCATION
CITY & STATE Johns River

SITE ADDRESS Wakarusa

PROJECT Malholtra SITE NO. 9

INSTRUMENT LAST CALIBRATED _____

MOTOR IDENTIFICATION NO. 22

ROTAMETER IDENTIFICATION NO. _____

FILTER NUMBER 5166925

START SAMPLING 8 2 85 9 57
mo day yr hr min CFM

STOP SAMPLING 8 3 85 9 03
mo day yr hr min CFM

ELAPSED TIME METER READING 104838 118765
Initial Final

WIND: _____ calm, _____ light, _____ gusty

VISIBILITY: _____ clear, _____ hazy

SKY: _____ clear, _____ scattering

_____ overcast

HUMIDITY: _____ dry, _____ moderate

_____ humid

TEMPERATURE °F: _____ <20, _____ 20-40,
_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight
- Flowrate must be \pm 10% of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines

Signature _____

REMARKS: 128.7

HI-VOL DATA RECORD
(Continued)

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: Open at 5:17 PM and started

Time	AP	TP	P	WS	WD	gas
9:32	3.3	70	28.9	calm	-	filled ✓
12:09		75	28.33	S	SW	✓
13:27		75	28.36	S-S	WNW	✓
19:05		65	28.77	calm	-	✓
05:17						
8:10	3.5					

STATION LOCATION Trinity Memorial
CITY & STATE Warren, Michigan
SITE ADDRESS Warren
PROJECT Makina SITE NO. 10
INSTRUMENT LAST CALIBRATED _____
MOTOR IDENTIFICATION NO. 18
ROTAMETER IDENTIFICATION NO. _____
FILTER NUMBER 5166929
START SAMPLING 8 2 85 9 32
no day yr hr min CFM
STOP SAMPLING 8 3 85 8 10
no day yr hr min CFM
ELAPSED TIME METER READING 10386.2 11619
initial final

WIND: _____ calm, _____ light, _____ moderate, _____ strong
VISIBILITY: _____ clear, _____ hazy, _____ foggy
SKY: _____ clear, _____ scattered, _____ overcast

HUMIDITY: _____ dry, _____ moderate, _____ humid
TEMPERATURE °F: _____ <20, _____ 20-40, _____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight
- Flowrate must be ± 10% of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines

Signature _____

REMARKS: 1231.8 min

HI-VOL DATA RECORD
(Continued)

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: _____

Time	DP	T	P	WS	WD	gao filed
19:46	4.2	80	28.58	0-5	SW	✓
04:15		81	28.59	0-5	SW	✓
07:45		85	28.62	4.5	SW	✓
13:30		82	28.62	4.5	NW	✓
18:40	4.1	90	28.55	4.5	SE	

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

STATION LOCATION Johns Manville
CITY & STATE _____

SITE ADDRESS Waukegan

PROJECT Malhotra SITE NO. 1

INSTRUMENT LAST CALIBRATED _____

MOTOR IDENTIFICATION NO. 21

ROTAMETER IDENTIFICATION NO. _____

FILTER NUMBER 5166935

START SAMPLING 8 05 85 15 46
mo day yr hr min CFM

STOP SAMPLING 8 06 85 18 40
mo day yr hr min CFM

ELAPSED TIME METER READING 13498.8 13935
Initial Final

WIND: _____ calm, _____ light, _____ zesty

VISIBILITY: _____ clear, _____ hazy

SKY: _____ clear, _____ scattering
_____ overcast

HUMIDITY: _____ dry, _____ moderate
_____ humid

TEMPERATURE °F: _____ <20, _____ 20-40,
_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight
- Flowrate must be ± 10% of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines

Signature _____

REMARKS: 13792

HI-VOL DATA RECORD
(Continued)

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: Stopped at 45050.7 at 19.13
(9/6).

Time	AP	T	P	WS	WD	Gas Filled
19:52	20	80	28.58	0.5	SW	✓
04:29		81	28.59	0.5	SW	✓
4.51		85	28.62	0.5	SW	✓
13:35		82	28.62	0.5	NW	✓
19:13	1.4	78	29.58	0.5	SE	

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

STATION LOCATION _____
CITY & STATE John Mlawille
SITE ADDRESS Wahagan
PROJECT Malhalla SITE NO. 2
INSTRUMENT LAST CALIBRATED _____
MOTOR IDENTIFICATION NO. 11
ROTAMETER IDENTIFICATION NO. _____
FILTER NUMBER 5166936
START SAMPLING 08 05 85 19 52
no day yr hr min CFM
STOP SAMPLING 08 06 85 19 13
no day yr hr min CFM
ELAPSED TIME METER READING 440.21 45050
Initial

WIND: _____ calm, _____ light, _____ gusty
VISIBILITY: _____ clear, _____
SKY: _____ clear, _____ scattering
_____ overcast

HUMIDITY: _____ dry, _____ moderate
_____ humid

TEMPERATURE °F: _____ <20, _____ 20-40,
_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight
- Flowrate must be ± 10% of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines

Signature _____

REMARKS: 10636

HI-VOL DATA RECORD
(Continued)

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: GENERATOR OUT FOR
EXACTLY 30 min.

Time	ΔP	T	P	WS	WZ	WZ
20:05	2.4	80	28.58	0.5	SW	✓
04:38		81	28.59	0.5	SW	✓
7:56		85	28.62	4.5	SW	✓
13:40		82	28.62	4.5	NW	✓
19:30	2.2					

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

STATION LOCATION
CITY & STATE Johns River

SITE ADDRESS Waukegan

PROJECT Waukegan SITE NO. 3

INSTRUMENT LAST CALIBRATED _____

MOTOR IDENTIFICATION NO. 4

ROTAMETER IDENTIFICATION NO. _____

FILTER NUMBER 5166932

START SAMPLING 08 05 85 20 07
mo day yr hr min CFM

STOP SAMPLING 08 06 85 19 30
mo day yr hr min CFM

ELAPSED TIME METER READING 28.55 19.30
Initial Final

WIND: _____ calm, _____ light, _____ gusty

VISIBILITY: _____ clear, _____ hazy

SKY: _____ clear, _____ scattering

_____ overcast

HUMIDITY: _____ dry, _____ moderate

_____ humid

TEMPERATURE °F: _____ <20, _____ 20-40,

_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight
- Flowrate must be ± 10% of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines

Signature _____

REMARKS: 1600 min

HI-VOL DATA RECORD
(Continued)

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: stopped at 15:26 (8/6)

Time	DP	T	P	WS	WD	gas filled
20:12	305	80		<5	SW	✓
04:46		81	28.58	0.5	SW	✓
7:58		85	28.62	<5	SW	✓
13:45		82	28.62	<5	NW	✓
19:45						

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

STATION LOCATION
CITY & STATE John Marville
SITE ADDRESS Waukegan
PROJECT Malhotra SITE NO. 4

INSTRUMENT LAST CALIBRATED _____
MOTOR IDENTIFICATION NO. 1

ROTAMETER IDENTIFICATION NO. _____
FILTER NUMBER 51667 39

START SAMPLING 08 05 85 20 12
mo day yr hr min CFM

STOP SAMPLING 08 06 85 19 45
mo day yr hr min CFM

ELAPSED TIME METER READING 20:12 15:26
Initial Final

WIND: _____ calm, _____ light, _____ gusty

VISIBILITY: _____ clear, _____ h

SKY: _____ clear, _____ scattering

_____ overcast

HUMIDITY: _____ dry, _____ moderate
_____ humid

TEMPERATURE °F: _____ <20, _____ 20-40,
_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight
- Flowrate must be ± 10% of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines

Signature _____

REMARKS: 1214

HI-VOL DATA RECORD
(Continued)

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: _____

Time	DP	T	P	WS	WD	Gas
20:23	18	78	28.58	<5	SW	✓
04:51		81	28.59	0-5	SW	✓
7:55		85	28.62	<5	SW	✓
13:50		92	28.62	<5	NW	✓
19:50	1.9					

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
23711 Southfield Road
Southfield, Michigan 48075

STATION LOCATION _____
CITY & STATE John M. White
SITE ADDRESS Lebanon
PROJECT Waltham SITE NO. 5
INSTRUMENT LAST CALIBRATED _____
MOTOR IDENTIFICATION NO. 3
ROTAMETER IDENTIFICATION NO. _____
FILTER NUMBER 5166938
START SAMPLING 08 05 85 20 23
mo day yr hr min CFM
STOP SAMPLING 08 06 85 19 50
mo day yr hr min CFM
ELAPSED TIME METER READING 20:23 19:50
Initial Final

WIND: _____ calm, _____ light, _____ gusty

VISIBILITY: _____ clear, _____ hazy

SKY: _____ clear, _____ scattering

_____ overcast

HUMIDITY: _____ dry, _____ moderate

_____ humid

TEMPERATURE °F: _____ <20, _____ 20-40,
_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight
- Flowrate must be ± 10% of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines

Signature _____

REMARKS: 1407 min

HI-VOL DATA RECORD
(Continued)

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: _____

Time	DP	TP	WS	WD
20:29	4.9	75	45	SW
04:53		81	28.59	0.5 SW
7:59		85	28.62	<5 SW
14:00		82	28.62	<5 NW
20:00	4.3			

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

STATION LOCATION
CITY & STATE John M. Wauville
SITE ADDRESS Wauville
PROJECT Malholtra SITE NO. 6
INSTRUMENT LAST CALIBRATED _____
MOTOR IDENTIFICATION NO. 25
ROTAMETER IDENTIFICATION NO. 516940
FILTER NUMBER 2
START SAMPLING 08 05 88 20 29
no day yr hr min CFM
STOP SAMPLING 08 06 88 20 00
no day yr hr min CFM
ELAPSED TIME METER READING 11787.9 13199.0
Initial Final

WIND: _____ calm, _____ light, _____ gusty,

VISIBILITY: _____ clear, _____ ha

SKY: _____ clear, _____ scattering, _____ overcast

HUMIDITY: _____ dry, _____ moderate

_____ humid

TEMPERATURE °F: _____ <20, _____ 20-40,

_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight
- Flowrate must be + 10% of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines

Signature _____

REMARKS: 1418-1

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

HI-VOL DATA RECORD
(Continued)

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: _____

Time	ΔP	T	P	WS	WD
19:36	4.1	75	28.55	<5	SW
05:05		81	28.59	0-5	SW
8:02		85	28.62	<5	SW
16:25		82	28.62	<5	NW
18:38	4.0	78	28.58		

STATION LOCATION
CITY & STATE Johns RiverSITE ADDRESS W. K. KaganPROJECT W. K. Kagan SITE NO. 7

INSTRUMENT LAST CALIBRATED _____

MOTOR IDENTIFICATION NO. 19

ROTAMETER IDENTIFICATION NO. _____

FILTER NUMBER A 5166934START SAMPLING 08 05 85 19 36
mo day yr hr min CFMSTOP SAMPLING 08 06 85 18 38
mo day yr hr min CFMELAPSED TIME METER READING 11253.6 13148.5
Initial Final

WIND: _____ calm, _____ light, _____ gusty

VISIBILITY: _____ clear, _____ hazy

SKY: _____ clear, _____ scattering

_____ overcast

HUMIDITY: _____ dry, _____ moderate

_____ humid

TEMPERATURE °F: _____ <20, _____ 20-40,
_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight
- Flowrate must be ± 10% of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance
with the above guidelines

Signature _____

REMARKS: 15925

HI-VOL DATA RECORD
(Continued)

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: Moved the lawn on
which sampler was placed.

Time	AP	T	P	WS	WD
19:15	3.0	73	28.55	45	SE
19:25	3.5	80	28.28	calm	-

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

STATION LOCATION
CITY & STATE Troy, Michigan

SITE ADDRESS 11111

PROJECT Maintenance SITE NO. 8

INSTRUMENT LAST CALIBRATED _____

MOTOR IDENTIFICATION NO. 20

ROTAMETER IDENTIFICATION NO. A5766942

FILTER NUMBER _____

START SAMPLING 08 05 85 19 15
mo day yr hr min CFM

STOP SAMPLING 08 06 85 18 25
mo day yr hr min CFM

ELAPSED TIME METER READING 1137.8
Initial F

WIND: _____ calm, _____ light, _____ gusty

VISIBILITY: _____ clear, _____ h

SKY: _____ clear, _____ scattering
_____ overcast

HUMIDITY: _____ dry, _____ moderate
_____ humid

TEMPERATURE °F: _____ <20, _____ 20-40,
_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight
- Flowrate must be ± 10% of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines

Signature [Signature]

REMARKS: 137.6

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

HI-VOL DATA RECORD
(Continued)

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: _____

Time	DP	T	P	WS	WD
19:25	3.7	78	28.58	45	SE
8:15	3.0	80	28.58	Calm	-

STATION LOCATION _____
CITY & STATE Tahlequah
SITE ADDRESS Wahkiakum
PROJECT Wahkiakum SITE NO. 9
INSTRUMENT LAST CALIBRATED _____
MOTOR IDENTIFICATION NO. 22
ROTAMETER IDENTIFICATION NO. _____
FILTER NUMBER A-5166943
START SAMPLING 08 5 35 19 25
mo day yr hr min CFM
STOP SAMPLING 08 06 55 18 15
mo day yr hr min CFM
ELAPSED TIME METER READING 113459
Initial Final

WIND: _____ calm, _____ light, _____ gusty

VISIBILITY: _____ clear, _____ hazy

SKY: _____ clear, _____ scattering

_____ overcast

HUMIDITY: _____ dry, _____ moderate

_____ humid

TEMPERATURE °F: _____ <20, _____ 20-40,
_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight
- Flowrate must be ± 10% of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines.

Signature _____

REMARKS: 13209

HI-VOL DATA RECORD
(Continued)

Net Particulate Wgt. _____ grams
Air Volume _____ m³
Particulate Concentration _____ µg/m³
Total Sampling Time _____ hours _____ minutes

REMARKS: _____

Time	ΔP	T	P	WS	WD	gas filled
20:35	3.2	73	2858	45	SE	✓
05:01		81	2859	0.5	SW	✓
8:12		85	2862	45	SW	✓
14:10		82	2862	45	NW	✓
20:12	31					

HI-VOL DATA RECORD

Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075

STATION LOCATION _____
CITY & STATE Ann Arbor, MI
SITE ADDRESS 1440 Kagan
PROJECT Michigan SITE NO. 10
INSTRUMENT LAST CALIBRATED _____
MOTOR IDENTIFICATION NO. 18
ROTAMETER IDENTIFICATION NO. _____
FILTER NUMBER 5166941
START SAMPLING 08 05 85 20 35
mo day yr hr min CFM
STOP SAMPLING 08 06 85 20 12
mo day yr hr min CFM

ELAPSED TIME METER READING 116A 1395
Initial

WIND: _____ calm, _____ light, _____ gusty

VISIBILITY: _____ clear, _____ h

SKY: _____ clear, _____ scattering
_____ overcast

HUMIDITY: _____ dry, _____ moderate
_____ humid

TEMPERATURE °F: _____ <20, _____ 20-40,
_____ 41-60, _____ 61-80, _____ >80

- Faceplate must be hand tight
- Flowrate must be ± 10% of established flowrate
- Faceplate gasket must be in good condition
- Rotameter must be free of foreign material
- Rotameter operation must be stable
- Sampler motor brushes must be changed every 400 hrs of operation

Sample was collected in accordance with the above guidelines

Signature _____

REMARKS: 1364

APPENDIX B
FIELD DATA SUMMARY SHEETS

Ambient air analysis

Job number: 27735-13

Client: Malhotra

Location: Johns Marville

City: Waukegan, Illinois

Date: Aug 1-Aug 2, 1985

Site	Sampling time (min)	Pump Number	Delta H Average	Pump flowrate(SCFM) Start Stop	Total Vol (cu. m)	TSP (milligr)	Lead (milligr)	TSP (microgr. per cu.m)	Lead (microgr. per cu.m)	Filter Number
1 *	1455	21	3.4	59 59	2431.9	135.5	0.05	55.5	0.0123	5166922
2 *	1299	11	1.45	87.5 97.5	3220.0	37.3	0.04	11.4	0.0062	5166917
3 *	825	7	2.45	81 81	1893.1	15.6	0.02	8.0	0.0060	5166921
4 *	1036	1	3.3	90 90	2641.4	19.6	0.02	7.2	0.0060	5166920
5 *	1396	3	1.9	81 81	3203.4	40.5	0.05	12.5	0.0094	5166913
6	1460	25	3.5	51 51	2109.4	23.8	0.02	11.0	0.0060	5166923
7	1458	19	3.7	53 53	2189.1	67.9	0.05	30.8	0.0137	5166916
8	1459	20	3.9	55 55	2273.3	38.2	0.14	16.6	0.0528	5166918
9	1458	22	3.7	53 53	2189.1	28.2	0.05	12.7	0.0137	5166919
10 *	1418	18	3.25	46 46	1847.9	18.5	0.04	9.7	0.0108	5166915

* indicates the sites with generators

Ambient air analysis

Job number: 27735-13

Client: Malhotra

Location: Johns Manville

City: Waukegan, Illinois

Date: Aug 2-Aug 3, 1985

Site Number	Sampling time (min)	Pump Number	Delta H Average	Pump flowrate(SCFM) Start Stop	Total Vol (cu. m)	TSP (milligr)	Lead (milligr)	TSP (microgr. per cu.m)	Lead (microgr. per cu.m)	Filter Number
1 *	1395	21	4.2	56 56	2213.1	230.9	0.13	104.0	0.04970	5166933
2 *	1129	11	1.5	90 90	2878.6	68.8	0.18	23.6	0.05558	5166932
3 *	1433	4	2.1	81 81	3288.3	52.2	0.16	15.6	0.04257	5166931
4 *	1270	1	3.2	90 90	3238.1	41.4	0.14	12.5	0.03705	5166930
5 *	433	3	1.8	79 79	969.08	26	0.04	26.0	0.02063	5166926
6	1374	25	4.5	58 58	2257.6	74.8	0.11	32.8	0.03986	5166914
7	1344	19	3.9	54 54	2056.0	132.3	0.18	64.0	0.07781	5166928
8	1329	20	4.1	57 57	2146.0	51	0.25	23.4	0.10717	5166927
9	1387	22	3.5	51 51	2003.9	74.8	0.11	36.9	0.04491	5166925
10 *	1233	18	3.4	48 48	1676.6	33.7	0.07	19.6	0.02982	5166929

* indicates sites with generators

Ambient air analysis

Job number: 27735-13

Client: Malhotra

Location: Johns Manville

City: Waukegan, Illinois

Date: Aug 5-Aug 6, 1985

Site	Sampling time (min)	Pump Delta H Number Average	Pump flowrate(SCFM) Start Stop	Total Vol (cu. m)	TSP (milligr)	Lead (milligr)	TSP (microgr. per cu.m)	Lead (microgr. per cu.m)	Filter Number
1 *	1379	21 4.2	56 56	2187.7	144	0.07	65.4	0.02285	5166935
2 *	1069	11 1.7	64 64	1938.2	78.6	0.09	40.0	0.03611	5166936
3 *	1400	4 2.3	87 87	3450.5	100.4	0.09	28.8	0.02028	5166937
4 *	1214	1 3.1	90 90	2095.3	66.4	0.09	21.1	0.02261	5166939
5 *	1407	3 1.9	81 81	3228.6	121.6	0.16	37.4	0.04336	5166938
6	1411	25 4.6	59 59	2358.4	85.5	0.07	35.8	0.02120	5166940
7	1393	19 4.1	56 56	2209.9	72.4	0.04	32.3	0.00904	5166934
8	1381	20 3.3	51 51	1995.3	56.3	0.11	27.7	0.04510	5166942
9	1381	22 3.4	50 50	1956.1	46.7	0.04	23.4	0.01022	5166943
10 *	1364	18 3.2	45 45	1738.8	54.6	0.04	30.8	0.0115	5166941

* indicates the sites with generators

APPENDIX C
METEOROLOGICAL DATA SUMMARY

METEOROLOGICAL DATA

August 1 - 2, 1985

Johns Manville
Waukegan, IL

<u>Time</u>	<u>Barometric Pressure (Hg)</u>	<u>Ambient Temperature (°F)</u>	<u>Wind Speed (m/s)</u>	<u>Wind Direction</u>
11:32	28.80	80	7	NNW
16:00	28.81	68	5-6	N
19:50	28.82	67	< 5	S
00:20	28.82	65	< 5	S

METEOROLOGICAL DATA

August 2 - 3, 1985

Johns Manville
Waukegan, IL

<u>Time</u>	<u>Barometric Pressure (Hg)</u>	<u>Ambient Temperature (°F)</u>	<u>Wind Speed (m/s)</u>	<u>Wind Direction</u>
08:33	28.90	65	Calm	—
11:33	28.88	72	3	SW
15:45	28.86	72	3	WNW
18:58	28.79	65	Calm	—
00:40	28.83	66	2	ESE
03:57	28.83	66	Calm	—

METEOROLOGICAL DATA

August 5 - 6, 1985

Johns Manville
Waukegan, IL

<u>Time</u>	<u>Barometric Pressure (Hg)</u>	<u>Ambient Temperature (°F)</u>	<u>Wind Speed (m/s)</u>	<u>Wind Direction</u>
19:46	28.58	80	5	SW
04:15	28.59	81	5	SW
07:45	28.62	85	5	SW
13:30	28.62	82	5	NW
18:40	28.58	80	5	SE

APPENDIX D
USEPA RECOMMENDED SAMPLING AND ANALYSIS PROCEDURES

ENVIRONMENTAL PROTECTION AGENCY REGULATIONS ON NATIONAL PRIMARY AND SECONDARY AMBIENT AIR QUALITY STANDARDS

(40 CFR 50; 36 FR 22384, November 25, 1971; as amended by Code of Federal Regulations, Volume 40, revised as of July 1, 1976; 41 FR 52686, December 1, 1976; 43 FR 46258, October 5, 1978; 44 FR 8220, February 8, 1979; 44 FR 37915, June 29, 1979; 46 FR 44163, September 3, 1981; 47 FR 54899, December 6, 1982; 48 FR 628, January 5, 1983; 48 FR 2529, January 20, 1983; Corrected by 48 FR 17355, April 22, 1983)

SUBCHAPTER C—AIR PROGRAMS

PART 50—NATIONAL PRIMARY AND SECONDARY AMBIENT AIR QUALITY STANDARDS

Authority: Sec. 109, Clean Air Act, as amended 42 U.S.C. 7409.

[Amended by 48 FR 628, January 5, 1983]

§ 50.1 Definitions.

(a) As used in this part, all terms not defined herein shall have the meaning given them by the Act.

(b) "Act" means the Clean Air Act, as amended (42 U.S.C. 1857-1857l, as amended by Pub. L. 91-604).

(c) "Agency" means the Environmental Protection Agency.

(d) "Administrator" means the Administrator of the Environmental Protection Agency.

(e) "Ambient air" means that portion of the atmosphere, external to buildings, to which the general public has access.

(f) "Reference method" means a method of sampling and analyzing the ambient air for an air pollutant that is specified as a reference method in an appendix to this part, or a method that has been designated as a reference method in accordance with Part 53 of this chapter; it does not include a method for which a reference method designation has been cancelled in accordance with §53.11 or §53.16 of this chapter.

(g) "Equivalent method" means a method of sampling and analyzing the ambient air for an air pollutant that has been designated as an equivalent method in accordance with Part 53 of this chapter; it does not include a method for which an equivalent method designation has been cancelled in accordance with §53.11 or §53.16 of this chapter.

(h) "Traceable" means that a local standard has been compared and certified either directly or via not more than one intermediate standard, to a primary standard such as a National Bureau of Standards Standard Reference Material (NBS SRM), or a

USEPA/NBS-approved Certified Reference Material (CRM).

[50.1 (h) added by 48 FR 2529, January 20, 1983]

§ 50.2 Scope.

(a) National primary and secondary ambient air quality standards under section 109 of the Act are set forth in this part.

(b) National primary ambient air quality standards define levels of air quality which the Administrator judges are necessary, with an adequate margin of safety, to protect the public health. National secondary ambient air quality standards define levels of air quality which the Administrator judges necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Such standards are subject to revision, and additional primary and secondary standards may be promulgated as the Administrator deems necessary to protect the public health and welfare.

(c) The promulgation of national primary and secondary ambient air quality standards shall not be considered in any manner to allow significant deterioration of existing air quality in any portion of any State.

(d) The proposal, promulgation, or revision of national primary and secondary ambient air quality standards shall not prohibit any State from establishing ambient air quality standards for that State or any portion thereof which are more stringent than the national standards.

§ 50.3 Reference conditions.

All measurements of air quality are corrected to a reference temperature of 25° C. and to a reference pressure of 760 millimeters of mercury (1,013.2 millibars).

§ 50.4 National primary ambient air quality standards for sulfur oxides (sulfur dioxide).

The national primary ambient air quality standards for sulfur oxides

measured as sulfur dioxide by the reference method described in Appendix A to this part, or by an equivalent method, are:

(a) 80 micrograms per cubic meter (0.03 p.p.m.)—annual arithmetic mean.

(b) 365 micrograms per cubic meter (0.14 p.p.m.)—Maximum 24-hour concentration not to be exceeded more than once per year.

§ 50.5 National secondary ambient air quality standards for sulfur oxides (sulfur dioxide).

The national secondary ambient air quality standard for sulfur oxide measured as sulfur dioxide by the reference method described in Appendix A to this part, or by any equivalent method is 1,300 micrograms per cubic meter (0.5 p.p.m.) maximum 3-hour concentration not to be exceeded more than once per year.

§ 50.6 National primary ambient air quality standards for particulate matter.

The national primary ambient air quality standards for particulate matter, measured by the reference method described in Appendix B to this part, or by an equivalent method, are:

(a) 75 micrograms per cubic meter—annual geometric mean.

(b) 260 micrograms per cubic meter—maximum 24-hour concentration not to be exceeded more than once per year.

§ 50.7 National secondary ambient air quality standards for particulate matter.

The national secondary ambient air quality standards for particulate matter, measured by the reference method described in Appendix B to this part, or by an equivalent method, are:

(a) 60 micrograms per cubic meter—annual geometric mean, as a guide to

[Sec. 50.7(a)]

and Its Anomalous Behavior in Tetrachloromercurate (II). Submitted for publication in *Atmosphere Environment*, 1982.

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Appendix B—Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-Volume Method)

[Appendix B revised by 47 FR 54899, December 6, 1982]

1.0 Applicability.

1.1 This method provides a measurement of the mass concentration of total suspended particulate matter (TSP) in ambient air for determining compliance with the primary and secondary national ambient air quality standards for particulate matter as specified in § 50.6 and § 50.7 of this chapter. The measurement process is nondestructive, and the size of the sample collected is usually adequate for subsequent chemical analysis. Quality assurance procedures and guidance are provided in Part 58, Appendixes A and B, of this chapter and in References 1 and 2.

2.0 Principle.

2.1 An air sampler, properly located at the measurement site, draws a measured quantity of ambient air into a covered housing and through a filter during a 24-hr (nominal) sampling period. The sampler flow rate and the geometry of the shelter favor the collection of particles up to 25–50 μm (aerodynamic diameter), depending on wind speed and direction. (3) The filters used are specified to have a minimum collection

efficiency of 99 percent for 0.3 μm (DOP) particles (see Section 7.1.4).

2.2 The filter is weighed (after moisture equilibration) before and after use to determine the net weight (mass) gain. The total volume of air sampled, corrected to EPA standard conditions (25° C, 760 mm Hg [101 kPa]), is determined from the measured flow rate and the sampling time. The concentration of total suspended particulate matter in the ambient air is computed as the mass of collected particles divided by the volume of air sampled, corrected to standard conditions, and is expressed in micrograms per standard cubic meter ($\mu\text{g}/\text{std m}^3$). For samples collected at temperatures and pressures significantly different than standard conditions, these corrected concentrations may differ substantially from actual concentrations (micrograms per actual cubic meter), particularly at high elevations. The actual particulate matter concentration can be calculated from the corrected concentration using the actual temperature and pressure during the sampling period.

3.0 Range.

3.1 The approximate concentration range of the method is 2 to 750 $\mu\text{g}/\text{std m}^3$. The upper limit is determined by the point at which the sampler can no longer maintain the specified flow rate due to the increased pressure drop of the loaded filter. This point is affected by particle size distribution, moisture content of the collected particles, and variability from filter to filter, among other things. The lower limit is determined by the sensitivity of the balance (see Section 7.10) and by inherent sources of error (see Section 6).

3.2 At wind speeds between 1.3 and 4.5 m/sec (3 and 10 mph), the high-volume air sampler has been found to collect particles up to 25 to 50 μm , depending on wind speed and direction. (3) For the filter specified in Section 7.1, there is effectively no lower limit on the particle size collected.

4.0 Precision.

4.1 Based upon collaborative testing, the relative standard deviation (coefficient of variation) for single analyst precision (repeatability) of the method is 3.0 percent. The corresponding value for interlaboratory precision (reproducibility) is 3.7 percent. (4)

5.0 Accuracy.

5.1 The absolute accuracy of the method is undefined because of the complex nature of atmospheric particulate matter and the difficulty in determining the "true" particulate matter concentration. This method provides a measure of particulate matter concentration suitable for the purpose specified under Section 1.0, Applicability.

6.0 Inherent Sources of Error.

6.1 *Airflow variation.* The weight of material collected on the filter represents the (integrated) sum of the product of the instantaneous flow rate times the

instantaneous particle concentration. Therefore, dividing this weight by the average flow rate over the sampling period yields the true particulate matter concentration only when the flow rate is constant over the period. The error resulting from a nonconstant flow rate depends on the magnitude of the instantaneous changes in the flow rate and in the particulate matter concentration. Normally, such errors are not large, but they can be greatly reduced by equipping the sampler with an automatic flow controlling mechanism that maintains constant flow during the sampling period. Use of a constant flow controller is recommended.*

6.2 Air volume measurement. If the flow rate changes substantially or nonuniformly during the sampling period, appreciable error in the estimated air volume may result from using the average of the presampling and postsampling flow rates. Greater air volume measurement accuracy may be achieved by (1) equipping the sampler with a flow controlling mechanism that maintains constant air flow during the sampling period,* (2) using a calibrated, continuous flow rate recording device to record the actual flow rate during the sampling period and integrating the flow rate over the period, or (3) any other means that will accurately measure the total air volume sampled during the sampling period. Use of a continuous flow recorder is recommended, particularly if the sampler is not equipped with a constant flow controller.

6.3 Loss of volatiles. Volatile particles collected on the filter may be lost during subsequent sampling or during shipment and/or storage of the filter prior to the postsampling weighing.(5) Although such losses are largely unavoidable, the filter should be reweighed as soon after sampling as practical.

6.4 Artifact particulate matter. Artifact particulate matter can be formed on the surface of alkaline glass fiber filters by oxidation of acid gases in the sample air, resulting in a higher than true TSP determination.(6 7) This effect usually occurs early in the sample period and is a function of the filter pH and the presence of acid gases. It is generally believed to account for only a small percentage of the filter weight gain, but the effect may become more significant where relatively small particulate weights are collected.

6.5 Humidity. Glass fiber filters are comparatively insensitive to changes in

*At elevated altitudes, the effectiveness of automatic flow controllers may be reduced because of a reduction in the maximum sampler flow.

relative humidity, but collected particulate matter can be hygroscopic.(8) The moisture conditioning procedure minimizes but may not completely eliminate error due to moisture.

6.6 Filter handling. Careful handling of the filter between the presampling and postsampling weighings is necessary to avoid errors due to loss of fibers or particles from the filter. A filter paper cartridge or cassette used to protect the filter can minimize handling errors. (See Reference 2, Section 2).

6.7 Nonsampled particulate matter. Particulate matter may be deposited on the filter by wind during periods when the sampler is inoperative. (9) It is recommended that errors from this source be minimized by an automatic mechanical device that keeps the filter covered during nonsampling periods, or by timely installation and retrieval of filters to minimize the nonsampling periods prior to and following operation.

6.8 Timing errors. Samplers are normally controlled by clock timers set to start and stop the sampler at midnight. Errors in the nominal 1,440-min sampling period may result from a power interruption during the sampling period or from a discrepancy between the start or stop time recorded on the filter information record and the actual start or stop time of the sampler. Such discrepancies may be caused by (1) poor resolution of the timer set-points, (2) timer error due to power interruption, (3) missetting of the timer, or (4) timer malfunction. In general, digital electronic timers have much better set-point resolution than mechanical timers, but require a battery backup system to maintain continuity of operation after a power interruption. A continuous flow recorder or elapsed time meter provides an indication of the sampler run-time, as well as indication of any power interruption during the sampling period and is therefore recommended.

6.9 Recirculation of sampler exhaust. Under stagnant wind conditions, sampler exhaust air can be resampled. This effect does not appear to affect the TSP measurement substantially, but may result in increased carbon and copper in the collected sample. (10) This problem can be reduced by ducting the exhaust air well away, preferably downwind, from the sampler.

7.0 Apparatus.
(See References 1 and 2 for quality assurance information.)

Note.—Samplers purchased prior to the effective date of this amendment are not subject to specifications preceded by (†).

7.1 Filter. (Filters supplied by the Environmental Protection Agency can be assumed to meet the following criteria.

Additional specifications are required if the sample is to be analyzed chemically.)

7.1.1 Size: $20.3 \pm 0.2 \times 25.4 \pm 0.2$ cm (nominal 8×10 in).

7.1.2 Nominal exposed area: 408.5 cm^2 (63 in²).

7.1.3 Material: Glass fiber or other relatively inert, nonhygroscopic material. (8)

7.1.4 Collection efficiency: 99 percent minimum as measured by the DOP test (ASTM-2986) for particles of $0.3 \mu\text{m}$ diameter.

7.1.5 Recommended pressure drop range: 42–54 mm Hg (5.6–7.2 kPa) at a flow rate of $1.5 \text{ std m}^3/\text{min}$ through the nominal exposed area.

7.1.6 pH: 6 to 10. (11)

7.1.7 Integrity: 2.4 mg maximum weight loss. (11)

7.1.8 Pinholes: None.

7.1.9 Tear strength: 500 g minimum for 20 mm wide strip cut from filter in weakest dimension. (See ASTM Test D828–60).

7.1.10 Brittleness: No cracks or material separations after single lengthwise crease.

7.2 Sampler. The air sampler shall provide means for drawing the air sample, via reduced pressure, through the filter at a uniform face velocity.

7.2.1 The sampler shall have suitable means to:

- a. Hold and seal the filter to the sampler housing.
- b. Allow the filter to be changed conveniently.

c. Preclude leaks that would cause error in the measurement of the air volume passing through the filter.

d. (†) Manually adjust the flow rate to accommodate variations in filter pressure drop and site line voltage and altitude. The adjustment may be accomplished by an automatic flow controller or by a manual flow adjustment device. Any manual adjustment device must be designed with positive detents or other means to avoid unintentional changes in the setting.

7.2.2 Minimum sample flow rate, heavily loaded filter: $1.1 \text{ m}^3/\text{min}$ (39 ft³/min).*

7.2.3 Maximum sample flow rate, clean filter: $1.7 \text{ m}^3/\text{min}$ (60 ft³/min).*

7.2.4 Blower Motor: The motor must be capable of continuous operation for 24-hr periods.

7.3 Sampler shelter.

(†) See note at beginning of Section 7.

* These specifications are in actual air volume units: to convert to EPA standard air volume units, multiply the specifications by $(P_a/P_{std})(298/T)$ where P_a and T are the barometric pressure in mm Hg (or kPa) and the temperature in K at the sampler, and P_{std} is 760 mm Hg (or 101 kPa).

7.3.1 The sampler shelter shall:

- a. Maintain the filter in a horizontal position at least 1 m above the sampler supporting surface so that sample air is drawn downward through the filter.
- b. Be rectangular in shape with a gabled roof, similar to the design shown in Figure 1.
- c. Cover and protect the filter and sampler from precipitation and other weather.
- d. Discharge exhaust air at least 40 cm from the sample air inlet.

e. Be designed to minimize the collection of dust from the supporting surface by incorporating a baffle between the exhaust outlet and the supporting surface.

7.3.2 The sampler cover or roof shall overhang the sampler housing somewhat, as shown in Figure 1, and shall be mounted so as to form an air inlet gap between the cover and the sampler housing walls. *This sample air inlet should be approximately uniform on all sides of the sampler. *The area of the sample air inlet must be sized to provide an effective particle capture air velocity of between 20 and 35 cm/sec at the recommended operational flow rate. The capture velocity is the sample air flow rate divided by the inlet area measured in a horizontal plane at the lower edge of the cover. *Ideally, the inlet area and operational flow rate should be selected to obtain a capture air velocity of 25 ± 2 cm/sec.

7.4 Flow rate measurement devices.

7.4.1 The sampler shall incorporate a flow rate measurement device capable of indicating the total sampler flow rate. Two common types of flow indicators covered in the calibration procedure are (1) an electronic mass flowmeter and (2) an orifice or orifices located in the sample air stream together with a suitable pressure indicator such as a manometer, or aneroid pressure gauge. A pressure recorder may be used with an orifice to provide a continuous record of the flow. Other types of flow indicators (including rotameters) having comparable precision and accuracy are also acceptable.

7.4.2 *The flow rate measurement device must be capable of being calibrated and read in units corresponding to a flow rate which is readable to the nearest $0.02 \text{ std m}^3/\text{min}$ over the range 1.0 to 1.8 $\text{std m}^3/\text{min}$.

7.5 Thermometer, to indicate the approximate air temperature at the flow rate measurement orifice, when temperature corrections are used.

7.5.1 Range: -40° to 50° C (223–323 K).

7.5.2 Resolution: 2° C (2 K).

7.6 Barometer, to indicate barometric pressure at the flow rate measurement orifice, when pressure corrections are used.

7.6.1 Range: 500 to 800 mm Hg (66–106 kPa).

7.6.2 Resolution: $\pm 5 \text{ mm Hg}$ (0.67 kPa).

7.7 Timing/control device.

7.7.1 The timing device must be capable of starting and stopping the sampler to obtain an elapsed run-time of $24 \text{ hr} \pm 1 \text{ hr}$ ($1.440 \pm 60 \text{ min}$).

7.7.2 Accuracy of time setting: $\pm 30 \text{ min}$, or better. (See Section 8.8).

7.8 Flow rate transfer standard, traceable to a primary standard. (See Section 9.2).

7.8.1 Approximate range: 1.0 to 1.8 m^3/min .

7.8.2 Resolution: $0.02 \text{ m}^3/\text{min}$.

7.8.3 Reproducibility: ± 2 percent (2 times coefficient of variation) over normal ranges of ambient temperature and pressure for the stated flow rate range. (See Reference 2, Section 2.)

7.8.4 Maximum pressure drop at 1.7 $\text{std m}^3/\text{min}$: 50 cm H_2O (5 kPa).

7.8.5 The flow rate transfer standard must connect without leaks to the inlet of the sampler and measure the flow rate of the total air sample.

7.8.6 The flow rate transfer standard must include a means to vary the sampler flow rate over the range of 1.0 to 1.8 m^3/min (35–64 ft^3/min) by introducing various levels of flow resistance between the sampler and the transfer standard inlet.

7.8.7 The Conventional type of flow transfer standard consists of: An orifice unit with adapter that connects to the inlet of the sampler, a manometer or other device to measure orifice pressure drop, a means to vary the flow through the sampler unit, a thermometer to measure the ambient temperature, and a barometer to measure ambient pressure. Two such devices are shown in Figures 2a and 2b. Figure 2a shows multiple fixed resistance plates, which necessitate disassembly of the unit each time the flow resistance is changed. A preferable design, illustrated in Figure 2b, has a variable flow restriction that can be adjusted externally without disassembly of the unit. Use of conventional, orifice-type transfer standard is assumed in the calibration procedure (Section 9). However, the use of other types of transfer standards meeting the above specifications, such as the one shown in Figure 2c, may be approved; see the note following Section 9.1.

7.9 Filter conditioning environment

7.9.1 Controlled temperature: between 15° and 30° C with less than $\pm 3^\circ \text{ C}$ variation during equilibration period.

[Corrected by 48 FR 17355, April 22, 1983]

7.9.2 Controlled humidity: Less than 50 percent relative humidity, constant within ± 5 percent.

7.10 Analytical balance.

7.10.1 Sensitivity: 0.1 mg.

7.10.2 Weighing chamber designed to accept an unfolded $20.3 \times 25.4 \text{ cm}$ (8 x 10 in) filter.

7.11 Area light source, similar to X-ray film viewer, to backlight filters for visual inspection.

7.12 Numbering device, capable of printing identification numbers on the filters before they are placed in the filter conditioning environment, if not numbered by the supplier.

8.0 Procedure.

(See References 1 and 2 for quality assurance information.)

8.1 Number each filter, if not already numbered, near its edge with a unique identification number.

8.2 Backlight each filter and inspect for pinholes, particles, and other imperfections; filters with visible imperfections must not be used.

8.3 Equilibrate each filter in the conditioning environment for at least 24-hr.

8.4 Following equilibration, weigh each filter to the nearest milligram and record this tare weight (W_i) with the filter identification number.

8.5 Do not bend or fold the filter before collection of the sample.

8.6 Open the shelter and install a numbered, preweighted filter in the sampler, following the sampler manufacturer's instructions. During inclement weather, precautions must be taken while changing filters to prevent damage to the clean filter and loss of sample from or damage to the exposed filter. Filter cassettes that can be loaded and unloaded in the laboratory may be used to minimize this problem (See Section 6.6).

[Corrected by 48 FR 17355, April 22, 1983]

8.7 Close the shelter and run the sampler for at least 5 min to establish run-temperature conditions.

8.8 Record the flow indicator reading and, if needed, the barometric pressure (P_s) and the ambient temperature (T_s) see NOTE following step 8.12). Stop the sampler. Determine the sampler flow rate (see Section 10.1); if it is outside the acceptable range (1.1 to 1.7 m^3/min [39–60 ft^3/min]), use a different filter, or adjust the sampler flow rate. Warning: Substantial flow adjustments may affect the calibration of the orifice-type flow indicators and may necessitate recalibration.

8.9 Record the sampler identification information (filter number, site location or identification number, sample date, and starting time).

8.10 Set the timer to start and stop the sampler such that the sampler runs 24-hrs. from midnight to midnight (local time).

[Corrected by 48 FR 17355, April 22, 1983]

(†) See note at beginning of Section 7.

*These specifications are in actual air volume units; to convert to EPA standard air volume units, multiply the specifications by $(P_a/P_{std})(298/T)$ where P_a and T are the barometric pressure in mm Hg (or kPa) and the temperature in K at the sampler, and P_{std} is 760 mm Hg (or 101 kPa).

8.11 As soon as practical following the sampling period, run the sampler for at least 5 min to again establish run-temperature conditions.

8.12 Record the flow indicator reading and, if needed, the barometric pressure (P_s) and the ambient temperature (T_s).

Note.—No onsite pressure or temperature measurements are necessary if the sampler flow indicator does not require pressure or temperature corrections (e.g., a mass flowmeter) or if average barometric pressure and seasonal average temperature for the site are incorporated into the sampler calibration (see step 9.3.9). For individual pressure and temperature corrections, the ambient pressure and temperature can be obtained by onsite measurements or from a nearby weather station. Barometric pressure readings obtained from airports must be station pressure, not corrected to sea level, and may need to be corrected for differences in elevation between the sampler site and the airport. For samplers having flow recorders but not constant flow controllers, the average temperature and pressure at the site during the sampling period should be estimated from weather bureau or other available data.

8.13 Stop the sampler and carefully remove the filter, following the sampler manufacturer's instructions. Touch only the outer edges of the filter. See the precautions in step 8.6.

8.14 Fold the filter in half lengthwise so that only surfaces with collected particulate matter are in contact and place it in the filter holder (glassine envelope or manila folder).

8.15 Record the ending time or elapsed time on the filter information record, either from the stop set-point time, from an elapsed time indicator, or from a continuous flow record. The sample period must be $1,440 \pm 60$ min. for a valid sample.

8.16 Record on the filter information record any other factors, such as meteorological conditions, construction activity, fires or dust storms, etc., that might be pertinent to the measurement. If the sample is known to be defective, void it at this time.

8.17 Equilibrate the exposed filter in the conditioning environment for at least 24-hrs.

8.18 Immediately after equilibration, reweigh the filter to the nearest milligram and record the gross weight with the filter identification number. See Section 10 for TSP concentration calculations.

9.0 Calibration.

9.1 Calibration of the high volume sampler's flow indicating or control device is necessary to establish traceability of the field measurement to a primary standard via a flow rate transfer standard. Figure 3a illustrates the certification of the flow rate transfer standard and Figure 3b illustrates its use in calibrating a sampler flow indicator. Determination of the corrected flow rate from the sampler flow indicator, illustrated in Figure 3c, is addressed in Section 10.1

Note.—The following calibration procedure applies to a conventional orifice-type flow transfer standard and an orifice-type flow indicator in the sampler (the most common types). For samplers using a pressure recorder having a square-root scale, 3 other acceptable calibration procedures are provided in Reference 12. Other types of transfer standards may be used if the manufacturer or user provides an appropriately modified calibration procedure that has been approved by EPA under Section 2.8 of Appendix C to Part 58 of this chapter.

9.2 Certification of the flow rate transfer standard.

9.2.1 **Equipment required:** Positive displacement standard volume meter traceable to the National Bureau of Standards (such as a Roots meter or equivalent), stop-watch, manometer, thermometer, and barometer.

9.2.2 Connect the flow rate transfer standard to the inlet of the standard volume meter. Connect the manometer to measure the pressure at the inlet of the standard volume meter. Connect the orifice manometer to the pressure tap on the transfer standard. Connect a high-volume air pump (such as a high-volume sampler blower) to the outlet side of the standard volume meter. See Figure 3a.

9.2.3 Check for leaks by temporarily clamping both manometer lines (to avoid fluid loss) and blocking the orifice with a large-diameter rubber stopper, wide cellophane tape, or other suitable means. Start the high-volume air pump and note any change in the standard volume meter reading. The reading should remain constant. If the reading changes, locate any leaks by listening for a whistling sound and/or retightening all connections, making sure that all gaskets are properly installed.

9.2.4 After satisfactorily completing the leak check as described above, unclamp both manometer lines and zero both manometers.

9.2.5 Achieve the appropriate flow rate through the system, either by means of the variable flow resistance in the transfer standard or by varying the voltage to the air pump. (Use of resistance plates as shown in Figure 1a is discouraged because the above leak check must be repeated each time a new resistance plate is installed.) At least five different but constant flow rates, even distributed, with at least three in the specified flow rate interval (1.1 to 1.7 m³/min [39 – 60 ft³/min]), are required.

9.2.6 Measure and record the certification data on a form similar to the one illustrated in Figure 4 according to the following steps.

9.2.7 Observe the barometric pressure and record as P_1 (item 8 in Figure 4).

9.2.8 Read the ambient temperature in the vicinity of the standard volume meter and record it as T_1 (item 9 in Figure 4).

9.2.9 Start the blower motor, adjust the flow, and allow the system to run for at least 1 min for a constant motor speed to be attained.

9.2.10 Observe the standard volume meter reading and simultaneously start a stopwatch. Record the initial meter reading (V_i) in column 1 of Figure 4.

9.2.11 Maintain this constant flow rate until at least 3 m³ of air have passed through the standard volume meter. Record the standard volume meter inlet pressure manometer reading as ΔP (column 5 in Figure 4), and the orifice manometer reading as ΔH (column 7 in Figure 4). Be sure to indicate the correct units of measurement.

9.2.12 After at least 3 m³ of air have passed through the system, observe the standard volume meter reading while simultaneously stopping the stopwatch. Record the final meter reading (V_f) in column 2 and the elapsed time (t) in column 3 of Figure 4.

9.2.13 Calculate the volume measured by the standard volume meter at meter conditions of temperature and pressures as $V_m = V_f - V_i$. Record in column 4 of Figure 4.

9.2.14 Correct this volume to standard volume (std m³) as follows:

$$V_{std} = V_m \frac{P_1 - \Delta P}{P_{std}} \frac{T_{std}}{T_1}$$

where:

V_{std} = standard volume, std m³

V_m = actual volume measured by the standard volume meter;

P_1 = barometric pressure during calibration, mm Hg or kPa;

ΔP = differential pressure at inlet to volume meter, mm Hg or kPa;

P_{std} = 760 mm Hg or 101 kPa;

T_{std} = 298 K;

T_1 = ambient temperature during calibration, K.

Calculate the standard flow rate (std m³/min) as follows:

$$Q_{std} = \frac{V_{std}}{t}$$

where:

Q_{std} = standard volumetric flow rate, std m³/min

t = elapsed time, minutes.

Record Q_{std} to the nearest 0.01 std m³/min in column 6 of Figure 4.

9.2.15 Repeat steps 9.2.9 through 9.2.14 for at least four additional constant flow rates, evenly spaced over the approximate range of 1.0 to 1.8 std m³/min (35–64 ft³/min).

9.2.16 For each flow, compute

$$\sqrt{\Delta H (P_1/P_{std})(298/T_1)}$$

(column 7a of Figure 4) and plot these value against Q_{std} as shown in Figure 3a. Be sure to use consistent units (mm Hg or kPa) for

barometric pressure. Draw the orifice transfer standard certification curve or calculate the linear least squares slope (m) and intercept (b) of the certification curve:

$$\sqrt{\Delta H (P_1/P_{std})(298/T_1)}$$

$= mQ_{std} + b$. See Figures 3 and 4. A certification graph should be readable to 0.02 std m³/min.

9.2.17 Recalibrate the transfer standard annually or as required by applicable quality control procedures. (See Reference 2.)

9.3 Calibration of sampler flow indicator.

Note.—For samplers equipped with a flow controlling device, the flow controller must be disabled to allow flow changes during calibration of the sampler's flow indicator, or the alternate calibration of the flow controller given in 9.4 may be used. For samplers using an orifice-type flow indicator downstream of the motor, do not vary the flow rate by adjusting the voltage or power supplied to the sampler.

9.3.1 A form similar to the one illustrated in Figure 5 should be used to record the calibration data.

9.3.2 Connect the transfer standard to the inlet of the sampler. Connect the orifice manometer to the orifice pressure tap, as illustrated in Figure 3b. Make sure there are no leaks between the orifice unit and the sampler.

9.3.3 Operate the sampler for at least 5 minutes to establish thermal equilibrium prior to the calibration.

9.3.4 Measure and record the ambient temperature, T_2 , and the barometric pressure, P_2 , during calibration.

9.3.5 Adjust the variable resistance or, if applicable, insert the appropriate resistance plate (or no plate) to achieve the desired flow rate.

9.3.6 Let the sampler run for at least 2 min to re-establish the run-temperature conditions. Read and record the pressure drop across the orifice (ΔH) and the sampler

flow rate indication (I) in the appropriate columns of Figure 5.

9.3.7 Calculate $\sqrt{\Delta H (P_2/P_{std})(298/T_2)}$ and determine the flow rate at standard conditions (Q_{std}) either graphically from the certification curve or by calculating Q_{std} from the least square slope and intercept of the transfer standard's transposed certification curve: $Q_{std} = 1/m \sqrt{\Delta H (P_2/P_{std})(298/T_2)} - b$. Record the value of Q_{std} on Figure 5.

[Corrected by 48 FR 17355, April 22, 1983]

9.3.8 Repeat steps 9.3.5, 9.3.6, and 9.3.7 for several additional flow rates distributed over a range that includes 1.1 to 1.7 std m³/min.

9.3.9 Determine the calibration curve by plotting values of the appropriate expression involving I, selected from Table 1, against Q_{std} . The choice of expression from Table 1 depends on the flow rate measurement device used (see Section 7.4.1) and also on whether the calibration curve is to incorporate geographic average barometric pressure (P_a) and seasonal average temperature (T_a) for the site to approximate actual pressure and temperature. Where P_a and T_a can be determined for a site for a seasonal period such that the actual barometric pressure and temperature at the site do not vary by more than ± 60 mm Hg (8 kPa) from P_a or $\pm 15^\circ$ C from T_a , respectively, then using P_a and T_a avoids the need for subsequent pressure and temperature calculation when the sampler is used. The geographic average barometric pressure (P_a) may be estimated from an altitude-pressure table or by making an (approximate) elevation correction of -26 mm Hg (-3.46 kPa) for each 305 m (1,000 ft) above sea level (760 mm Hg or 101 kPa). The seasonal average temperature (T_a) may be estimated from weather station or other records. Be sure to use consistent units (mm Hg or kPa) for barometric pressure.

[Corrected by 48 FR 17355, April 22, 1983]

9.3.10 Draw the sampler calibration curve or calculate the linear least squares slope

(m), intercept (b), and correlation coefficient of the calibration curve: [Expression from Table 1] $= mQ_{std} + b$. See Figures 3 and 5. Calibration curves should be readable to 0.02 std m³/min.

9.3.11 For a sampler equipped with a flow controller, the flow controlling mechanism should be re-enabled and set to a flow near the lower flow limit to allow maximum control range. The sample flow rate should be verified at this time with a clean filter installed. Then add two or more filters to the sampler to see if the flow controller maintains a constant flow; this is particularly important at high altitudes where the range of the flow controller may be reduced.

9.4 Alternate calibration of flow-controlled samplers. A flow-controlled sampler may be calibrated solely at its controlled flow rate, provided that previous operating history of the sampler demonstrates that the flow rate is stable and reliable. In this case, the flow indicator may remain uncalibrated but should be used to indicate any relative change between initial and final flows, and the sampler should be recalibrated more often to minimize potential loss of samples because of controller malfunction.

9.4.1 Set the flow controller for a flow near the lower limit of the flow range to allow maximum control range.

9.4.2 Install a clean filter in the sampler and carry out steps 9.3.2, 9.3.3, 9.3.4, 9.3.6, and 9.3.7.

9.4.3 Following calibration, add one or two additional clean filters to the sampler, reconnect the transfer standard, and operate the sampler to verify that the controller maintains the same calibrated flow rate; this is particularly important at high altitudes where the flow control range may be reduced.

**TABLE 1. EXPRESSIONS FOR PLOTTING
SAMPLER CALIBRATION CURVES**

Type of sampler flow rate measuring device	Expression	
	For actual pressure and temperature corrections	For incorporation of geographic average pressure and seasonal average temperature
Mass flowmeter	I	I
Orifice and pressure indicator	$I \sqrt{\left(\frac{P_2}{P_{std}}\right) \left(\frac{298}{T_2}\right)}$	$I \sqrt{\left(\frac{P_2}{P_a}\right) \left(\frac{T_a}{T_2}\right)}$
Rotameter, or orifice and pressure recorder having square root scale*	$I \sqrt{\left(\frac{P_2}{P_{std}}\right) \left(\frac{298}{T_2}\right)}$	$I \sqrt{\left(\frac{P_2}{P_a}\right) \left(\frac{T_a}{T_2}\right)}$

*This scale is recognizable by its nonuniform divisions and is the most commonly available for high-volume samplers.

**TABLE 2. EXPRESSIONS FOR DETERMINING FLOW RATE
DURING SAMPLER OPERATION**

Type of sampler flow rate measuring device	Expression	
	For actual pressure and temperature corrections	For use when geographic average pressure and seasonal average temperature have been incorporated into the sampler calibration
Mass flowmeter	I	I
Orifice and pressure indicator	$I \sqrt{\left(\frac{P_3}{P_{std}}\right) \left(\frac{298}{T_3}\right)}$	\sqrt{I}
Rotameter, or orifice and pressure recorder having square root scale*	$I \sqrt{\left(\frac{P_3}{P_{std}}\right) \left(\frac{298}{T_3}\right)}$	I

*This scale is recognizable by its nonuniform divisions and is the most commonly available for high-volume samplers.

10.0 Calculations of TSP Concentration.

10.1 Determine the average sampler flow rate during the sampling period according to steps 9.1.1 or 10.1.2 below.

10.1.1 For a sampler without a continuous flow recorder, determine the appropriate expression to be used from Table 2 corresponding to the one from Table 1 used in step 9.3.9. Using this appropriate expression, determine Q_{std} for the initial flow rate from the sampler calibration curve, either graphically or from the transposed regression equation:

[Appropriate expression from Table 2] - b)

Similarly, determine Q_{std} from the final flow reading, and calculate the average flow Q_{std} as one-half the sum of the initial and final flow rates.

10.1.2 For a sampler with a continuous flow recorder, determine the average flow rate device reading, I , for the period. Determine the appropriate expression from Table 2 corresponding to the one from Table 1 used in step 9.3.9. Then using this expression and the average flow rate reading, determine Q_{std} from the sampler calibration curve, either graphically or from the transposed regression equation:

$Q_{std} =$

[Appropriate expression from Table 2] - b)

If the trace shows substantial flow change during the sampling period, greater accuracy may be achieved by dividing the sampling period into intervals and calculating an average reading before determining Q_{std} .

10.2 Calculate the total air volume sampled as:

$$V = Q_{std} \times t$$

where:

V = total air volume sampled, in standard volume units, std m^3 ;

Q_{std} = average standard flow rate, $\text{std m}^3/\text{min}$;

t = sampling time, min.

[Corrected by 48 FR 17355, April 22, 1983]

10.3 Calculate and report the particulate matter concentration as:

$$TSP = \frac{(W_f - W_i) \times 10^6}{V}$$

where:

TSP = mass concentration of total suspended particulate matter, $\mu\text{g}/\text{std m}^3$;

W_i = initial weight of clean filter, g;

W_f = final weight of exposed filter, g;

V = air volume sampled, converted to standard conditions, std m^3 ;

10^6 = conversion of g to μg .

10.4 If desired, the actual particulate matter concentration (see Section 2.2) can be calculated as follows:

$$(TSP)_a = TSP (P_3/P_{std})(298/T_3)$$

where:

$(TSP)_a$ = actual concentration at field conditions, $\mu\text{g}/\text{m}^3$;

TSP = concentration at standard conditions, $\mu\text{g}/\text{std m}^3$;

P_3 = average barometric pressure during sampling period, mm Hg;

P_{std} = 760 mm Hg (or 101 kPa);

T_3 = average ambient temperature during sampling period, K.

11.0 References.

1. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume I, Principles. EPA-600/9-76-005, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, 1976.
2. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Ambient Air Specific Methods. EPA-600/4-77-027a, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, 1977.
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10. Patterson, R. K. Aerosol Contamination from High-Volume Sampler Exhaust. J. Air Poll. Cont. Assoc., Vol. 30 (169), 1980.

11. EPA Test Procedures for Determining pH and Integrity of High-Volume Air Filters. QAD/M-80.01, Available from the Methods Standardization Branch, Quality Assurance Division, Environmental Monitoring Systems Laboratory (MD-77), U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, 1980.

12. Smith, F., P. S. Wohlschlegel, R. S. C. Rogers, and D. J. Mulligan. Investigation of Flow Rate Calibration Procedures Associated with the High-Volume Method for Determination of Suspended Particulates. EPA-600/4-78-047, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina, June 1978.

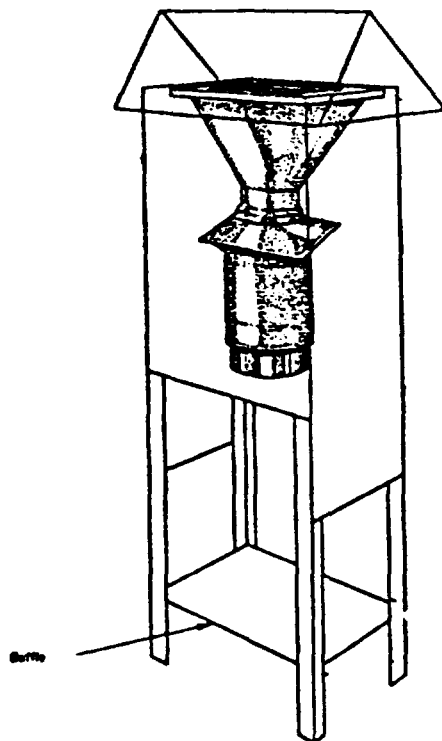
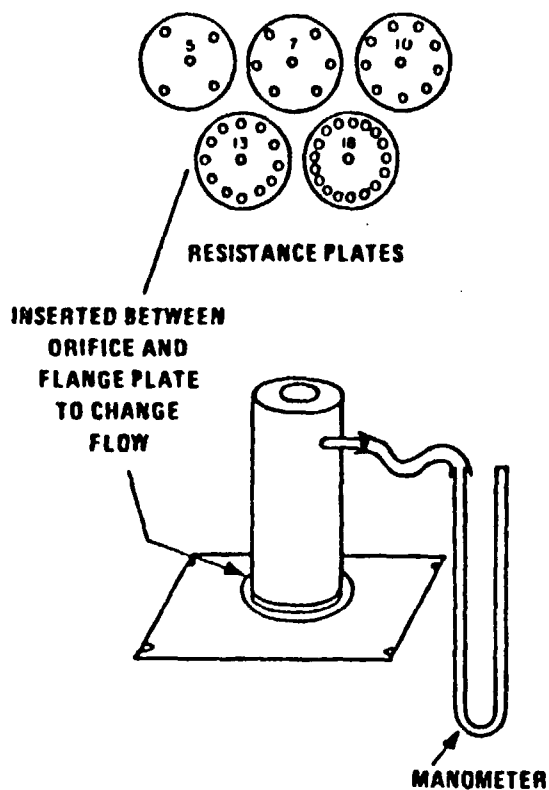


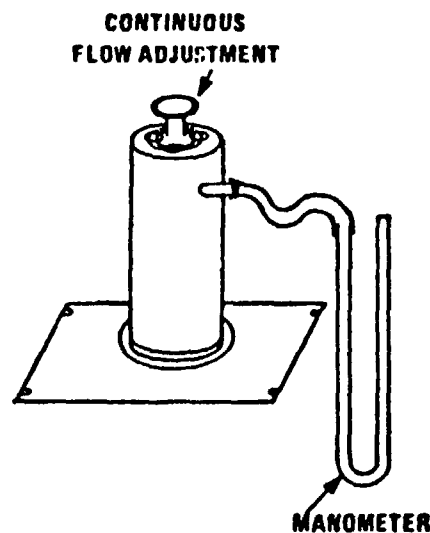
Figure 1. High-volume sampler in shelter.

ORIFICE TYPE FLOW TRANSFER STANDARDS

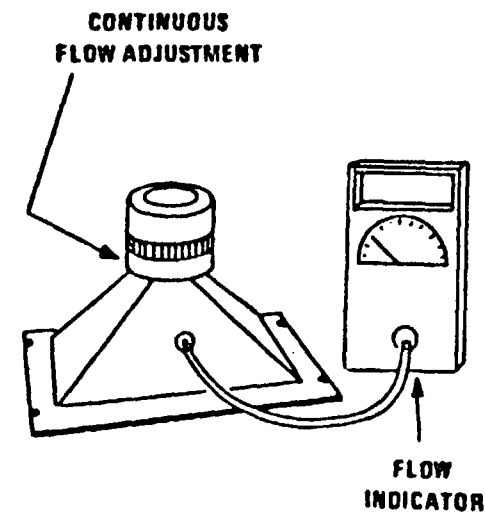
NONORIFICE TYPE FLOW TRANSFER STANDARD



2a. ORIFICE UNIT USING FIXED
RESISTANCE PLATES.



2b. PREFERABLE ORIFICE UNIT WITH
EXTERNALLY ADJUSTABLE
RESISTANCE.



2c. ELECTRONIC FLOWMETER WITH EXTERNALLY
ADJUSTABLE RESISTANCE.

Figure 2. Various types of flow transfer standards. Note that all devices are designed to mount to the filter inlet area of the sampler.

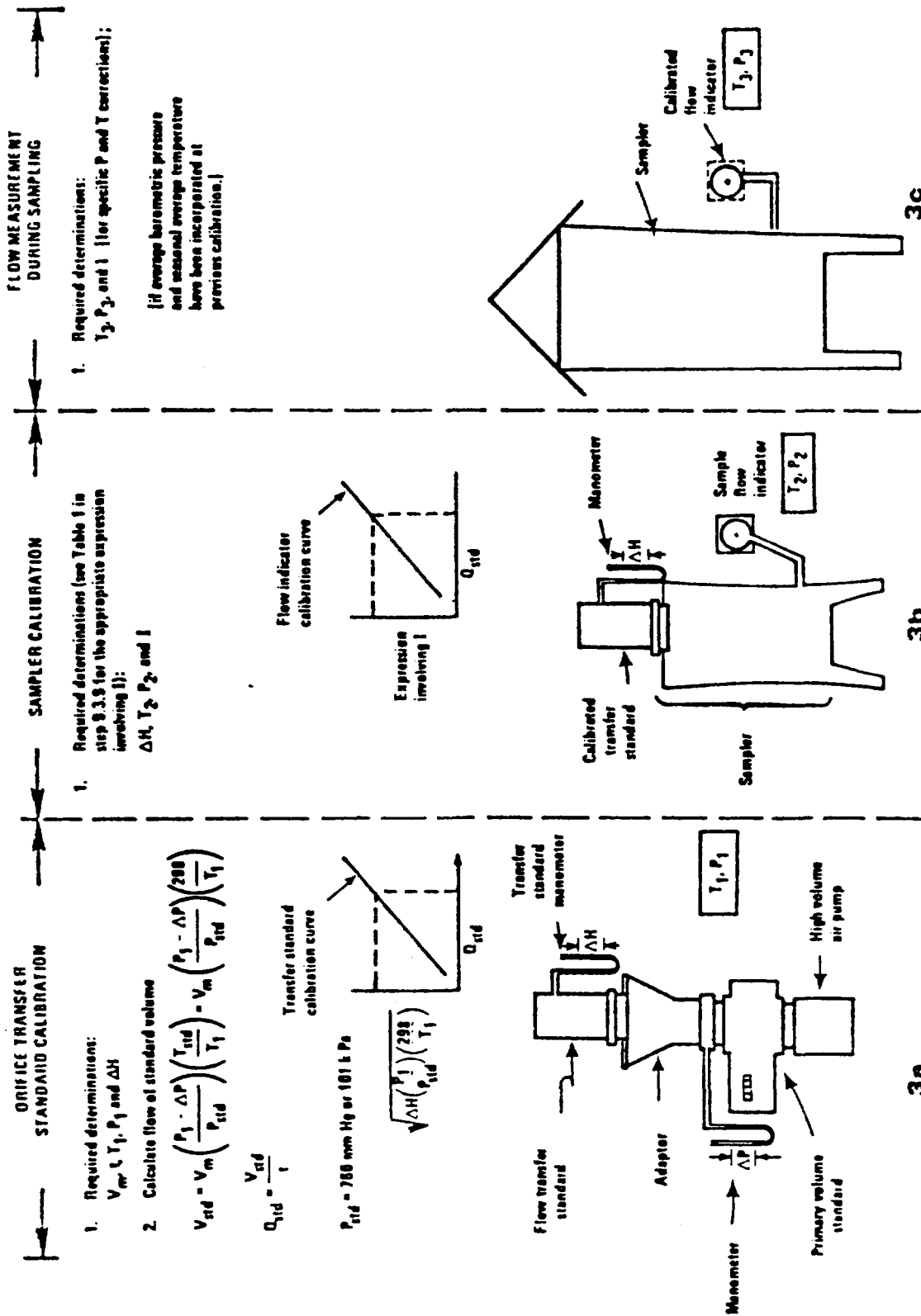


Figure 3. Illustration of the 3 steps in the flow measurement process.

ORIFICE TRANSFER STANDARD CERTIFICATION WORKSHEET

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(7a)
Meter reading start V_i (m ³)	Meter reading stop V_f (m ³)	Sampling time t (min)	Volume measured V_m (m ³)	Differential pressure (at inlet to volume meter) ΔP (mm Hg or kPa)	Flow rate Q_{std} (std m ³ /min)	Pressure drop across orifice ΔH (in) or ΔH (cm) of water	$\sqrt{\Delta H \left(\frac{P_i}{P_{std}} \right) \left(\frac{298}{T_i} \right)}$ (v)
Run No.							
1							
2							
3							
4							
5							
6							

RECORDED CALIBRATION DATA

Standard volume meter no. _____
 Transfer standard type: ☐ orifice ☐ other _____
 Model No. _____ Serial No. _____
 (8) P_i : _____ mm Hg (or kPa) (10) P_{std} : 760 mm Hg (or 101 kPa)
 (9) T_i : _____ K (11) T_{std} : 298 K
 Calibration performed by: _____
 Date: _____

CALCULATION EQUATIONS

(1) $V_m = V_f - V_i$
 (2) $V_{std} = V_m \left(\frac{P_i - \Delta P}{P_{std}} \right) \left(\frac{T_{std}}{T_i} \right)$
 (3) $Q_{std} = \frac{V_{std}}{t}$

LEAST SQUARES CALCULATIONS

Linear ($Y = mX + b$) regression equation of $Y = \sqrt{\Delta H(P_i/P_{std})(298/T_i)}$ on $X = Q_{std}$ for Orifice Calibration Unit (i.e., $\sqrt{\Delta H(P_i/P_{std})(298/T_i)} = mQ_{std} + b$)
 Slope (m) = _____ Intercept (b) = _____ Correlation coefficient (r) = _____

To use for subsequent calibration: $X = \frac{1}{m}(Y-b)$;
 $Q_{std} = \frac{1}{m} \left(\sqrt{\Delta H \left(\frac{P_i}{P_{std}} \right) \left(\frac{298}{T_i} \right)} - b \right)$

Figure 4. Example of orifice transfer standard certification worksheet.

HIGH-VOLUME AIR SAMPLER CALIBRATION WORKSHEET

Site Location: _____
 Date: _____ Barometric Pressure, P_2 mm Hg (or kPa) _____
 Calibrated By: _____ Temperature, T_2 (K) _____
 Sampler No. _____ Serial No. _____
 Transfer std. type: _____ Serial No. _____

(V)

$P_{std} = 760 \text{ mm Hg (or 101 kPa)}$ Optional: Average barometric pressure: $P_a =$ _____ Seasonal average temperature: $T_a =$ _____				For specific pressure and temperature corrections (see Table 1)	For incorporation of average pressure and seasonal average temperature (see Table 1)
No.	ΔH Pressure drop across orifice <input type="checkbox"/> (in) or <input type="checkbox"/> (cm) of water	$\sqrt{\Delta H \left(\frac{P_2}{P_{std}}\right) \left(\frac{298}{T_2}\right)}$	(X) Q_{std} (from orifice certification) std m ³ /min	<input type="checkbox"/> 1 or $\sqrt{1 \left(\frac{P_2}{P_{std}}\right) \left(\frac{298}{T_2}\right)}$ or $\sqrt{1 \left(\frac{P_2}{P_a}\right) \left(\frac{T_a}{T_2}\right)}$	<input type="checkbox"/> 1 or $\sqrt{1 \left(\frac{P_2}{P_a}\right) \left(\frac{T_a}{T_2}\right)}$ or $\sqrt{1 \left(\frac{P_2}{P_a}\right) \left(\frac{T_a}{T_2}\right)}$
1					
2					
3					
4					
5					
6					

LEAST SQUARES CALCULATIONS

Linear regression of Y on X: $Y = mX + b$; Y = appropriate expression from Table 1; $X = Q_{std}$

Slope (m) = _____ Intercept (b) = _____ Correlation Coeff. (r) = _____

To determine subsequent flow rate during use: $X = \frac{1}{m} (Y-b)$;

$Q_{std} = \frac{1}{m} ((\text{appropriate expression from Table 2}) - b)$

Figure 5. Example of high-volume air sampler calibration worksheet.

toring and Support Laboratory, Research Triangle Park, North Carolina 27711).

[References 14 and 15 added by 48 FR 2529, January 20, 1983]

14. A Procedure for Establishing Traceability of Gas Mixtures to Certain National Bureau of Standards Standard Reference Materials. EPA-600/7-81-010, Joint publication by NBS and EPA. Available from the U.S. Environmental Protection

Agency, Environmental Monitoring Systems Laboratory (MD-77), Research Triangle Park, North Carolina 27711, May 1981.

15. *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II. Ambient Air Specific Methods*. The U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Research Triangle Park, North Carolina 27711. Publication No. EAP-600/4-77-027a.

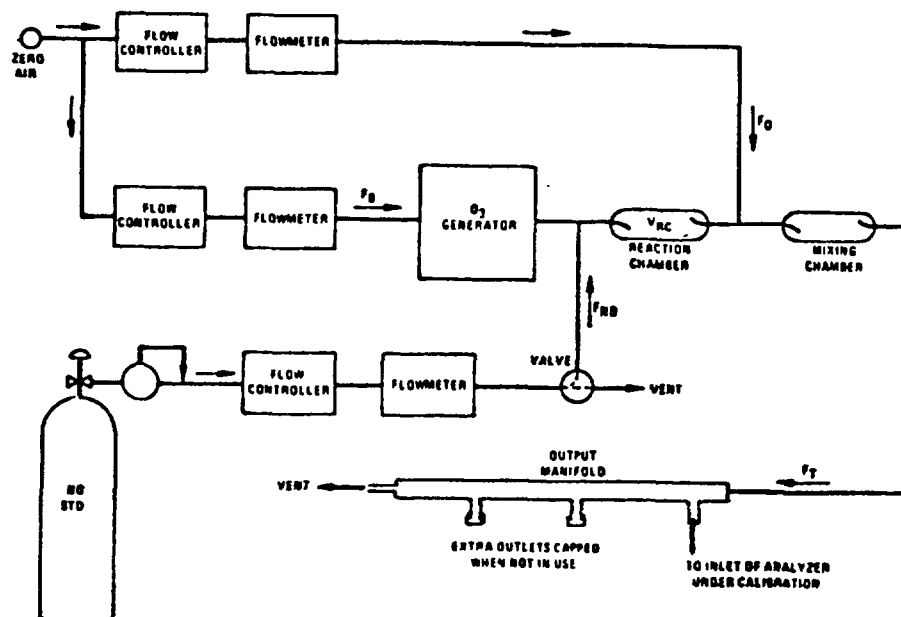


Figure 1. Schematic diagram of a typical GPT calibration system

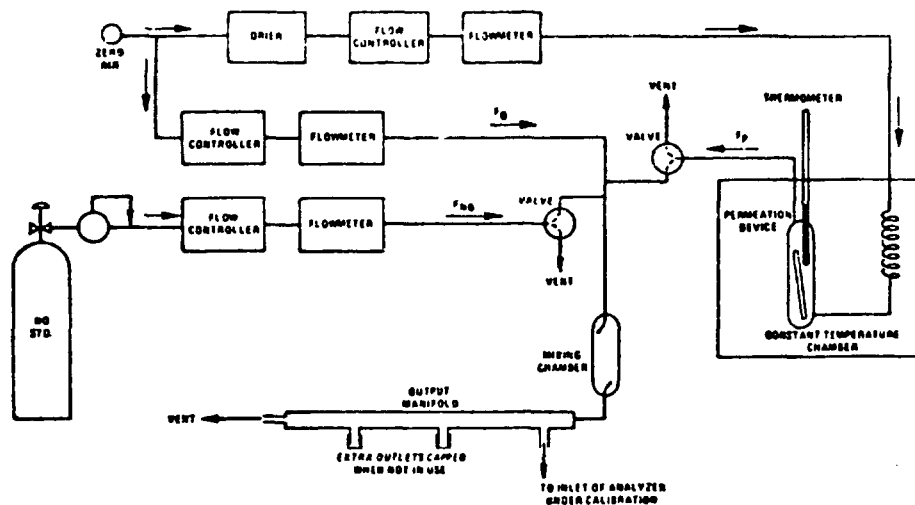


Figure 2. Schematic diagram of a typical calibration apparatus using an NO₂ permeation device

APPENDIX G—REFERENCE METHOD FOR THE DETERMINATION OF LEAD IN SUSPENDED PARTICULATE MATTER COLLECTED FROM AMBIENT AIR

1. Principle and applicability.

1.1 Ambient air suspended particulate matter is collected on a glass-fiber filter for 24 hours using a high volume air sampler.

The analysis of the 24-hour samples may be performed for either individual samples or composites of the samples collected over a calendar month or quarter, provided that the compositing procedure has been approved in accordance with section 2.8 of Appendix C to Part 58 of this chapter — *Modifications of methods by users*. (Guidance or assistance in requesting approval under Section

2.8 can be obtained from the address given in section 2.7 of Appendix C to Part 58 of this chapter.)

[Section 1.1 amended by 46 FR 44163, September 3, 1981]

1.2 Lead in the particulate matter is solubilized by extraction with nitric acid (HNO₃), facilitated by heat or by a mixture

[Appendix G]

of HNO₃ and hydrochloric acid (HCl) facilitated by ultrasonication.

1.3 The lead content of the sample is analyzed by atomic absorption spectrometry using an air-acetylene flame, the 283.3 or 217.0 nm lead absorption line, and the optimum instrumental conditions recommended by the manufacturer.

1.4 The ultrasonication extraction with HNO₃/HCl will extract metals other than lead from ambient particulate matter.

2. Range, sensitivity, and lower detectable limit. The values given below are typical of the methods capabilities. Absolute values will vary for individual situations depending on the type of instrument used, the lead line, and operating conditions.

2.1 Range. The typical range of the method is 0.07 to 7.5 µg Pb/m³ assuming an upper linear range of analysis of 15 µg/ml and an air volume of 2,400 m³.

2.2 Sensitivity. Typical sensitivities for a 1 percent change in absorption (0.0044 absorbance units) are 0.2 and 0.5 µg Pb/ml for the 217.0 and 283.3 nm lines, respectively.

2.3 Lower detectable limit (LDL). A typical LDL is 0.07 µg Pb/m³. The above value was calculated by doubling the between-laboratory standard deviation obtained for the lowest measurable lead concentration in a collaborative test of the method.⁽¹⁵⁾ An air volume of 2,400 m³ was assumed.

3. Interferences. Two types of interferences are possible: chemical and light scattering.

3.1 Chemical. Reports on the absence (1, 2, 3, 4, 5) of chemical interferences far outweigh those reporting their presence. (6) therefore, no correction for chemical interferences is given here. If the analyst suspects that the sample matrix is causing a chemical interference, the interference can be verified and corrected for by carrying out the analysis with and without the method of standard additions.⁽⁷⁾

3.2 Light scattering. Nonatomic absorption or light scattering, produced by high concentrations of dissolved solids in the sample, can produce a significant interference, especially at low lead concentrations. (2) The interference is greater at the 217.0 nm line than at the 283.3 nm line. No interference was observed using the 283.3 nm line with a similar method.⁽¹⁾

Light scattering interferences can, however, be corrected for instrumentally. Since the dissolved solids can vary depending on the origin of the sample, the correction may be necessary, especially when using the 217.0 nm line. Dual beam instruments with a continuum source give the most accurate correction. A less accurate correction can be obtained by using a nonabsorbing lead line that is near the lead analytical line. Information on use of these correction techniques can be obtained from instrument manufacturers' manuals.

If instrumental correction is not feasible, the interference can be eliminated by use of the ammonium pyrrolidinecarbodithioate-methylisobutyl ketone, chelation-solvent extraction technique of sample preparation.⁽⁸⁾

4. Precision and bias.

4.1 The high-volume sampling procedure used to collect ambient air particulate matter has a between-laboratory relative standard deviation of 3.7 percent over the range 80 to 125 µg/m³.⁽⁹⁾ The combined extraction-analysis procedure has an average within-laboratory relative standard deviation of 5 to 6 percent over the range 1.5 to 15 µg Pb/ml, and an average between labo-

ratory relative standard deviation of 7 to 9 percent over the same range. These values include use of either extraction procedure.

4.2 Single laboratory experiments and collaborative testing indicate that there is no significant difference in lead recovery between the hot and ultrasonic extraction procedures.⁽¹⁵⁾

5. Apparatus.

5.1 Sampling.

5.1.1 High-volume sampler. Use and calibrate the sampler as described in reference 10.

5.2 Analysis.

5.2.1 Atomic absorption spectrophotometer. Equipped with lead hollow cathode or electrodeless discharge lamp.

5.2.1.1 Acetylene. The grade recommended by the instrument manufacturer should be used. Change cylinder when pressure drops below 50-100 psig.

5.2.1.2 Air. Filtered to remove particulate, oil, and water.

5.2.2 Glassware. Class A borosilicate glassware should be used throughout the analysis.

5.2.2.1 Beakers. 30 and 150 ml. graduated, Pyrex.

5.2.2.2 Volumetric flasks. 100-ml.

5.2.2.3 Pipettes. To deliver 50, 30, 15, 8, 4, 2, 1 ml.

5.2.2.4 Cleaning. All glassware should be scrupulously cleaned. The following procedure is suggested. Wash with laboratory detergent, rinse, soak for 4 hours in 20 percent (w/w) HNO₃, rinse 3 times with distilled-deionized water, and dry in a dust free manner.

5.2.3 Hot plate.

5.2.4 Ultrasonication water bath, unheated. Commercially available laboratory ultrasonic cleaning baths of 450 watts or higher "cleaning power," i.e., actual ultrasonic power output to the bath have been found satisfactory.

5.2.5 Template. To aid in sectioning the glass-fiber filter. See figure 1 for dimensions.

5.2.6 Pizza cutter. Thin wheel. Thickness <1mm.

5.2.7 Watch glass.

5.2.8 Polyethylene bottles. For storage of samples. Linear polyethylene gives better storage stability than other polyethylenes and is preferred.

5.2.9 Parafilm "M." American Can Co., Marathon Products, Nennah, Wis., or equivalent.

6. Reagents.

6.1 Sampling.

6.1.1 Glass fiber filters. The specifications given below are intended to aid the user in obtaining high quality filters with reproducible properties. These specifications have been met by EPA contractors.

6.1.1.1 Lead content. The absolute lead content of filters is not critical, but low values are, of course, desirable. EPA typically obtains filters with a lead content of <75 µg/filter.

It is important that the variation in lead content from filter to filter, within a given batch, be small.

6.1.1.2 Testing.

6.1.1.2.1 For large batches of filters (>500 filters) select at random 20 to 30 filters from a given batch. For small batches (<500 filters) a lesser number of filters may be taken. Cut one ¼"x8" strip from each

filter anywhere in the filter. Analyze all strips, separately, according to the directions in sections 7 and 8.

6.1.1.2.2 Calculate the total lead in each filter as

$$F_b = \mu\text{g Pb/ml} \times \frac{100 \text{ ml}}{\text{strip}} \times \frac{12 \text{ strips}}{\text{filter}}$$

where:

F_b = Amount of lead per 72 square inches of filter, µg.

6.1.1.2.3 Calculate the mean, F_m, of the values and the relative standard deviation (standard deviation/mean × 100). If the relative standard deviation is high enough so that, in the analysts opinion, subtraction of F_b (section 10.3) may result in a significant error in the µg Pb/m³ the batch should be rejected.

6.1.1.2.4 For acceptable batches, use the value of F_b to correct all lead analyses (section 10.3) of particulate matter collected using that batch of filters. If the analyses are below the LDL (section 2.3) no correction is necessary.

6.2 Analysis.

6.2.1 Concentrated (15.6 M) HNO₃. ACS reagent grade HNO₃ and commercially available redistilled HNO₃ has found to have sufficiently low lead concentrations.

6.2.2 Concentrated (11.7 M) HCl. ACS reagent grade.

6.2.3 Distilled-deionized water. (D.I. water).

6.2.4 3 M HNO₃. This solution is used in the hot extraction procedure. To prepare, add 192 ml of concentrated HNO₃ to D.I. water in a 1 l volumetric flask. Shake well, cool, and dilute to volume with D.I. water. Caution: Nitric acid fumes are toxic. Prepare in a well ventilated fume hood.

6.2.5 0.45 M HNO₃. This solution is used as the matrix for calibration standards when using the hot extraction procedure. To prepare, add 29 ml of concentrated HNO₃ to D.I. water in a 1 l volumetric flask. Shake well, cool, and dilute to volume with D.I. water.

6.2.6 2.6 M HNO₃ + 0 to 0.9 M HCl. This solution is used in the ultrasonic extraction procedure. The concentration of HCl can be varied from 0 to 0.9 M. Directions are given for preparation of a 2.6 M HNO₃ + 0.9 M HCl solution. Place 167 ml of concentrated HNO₃ into a 1 l volumetric flask and add 77 ml of concentrated HCl. Stir 4 to 6 hours, dilute to nearly 1 l with D.I. water, cool to room temperature, and dilute to 1 l.

6.2.7 0.40 M HNO₃ + X M HCl. This solution is used as the matrix for calibration standards when using the ultrasonic extraction procedure. To prepare, add 26 ml of concentrated HNO₃ plus the ml of HCl required, to a 1 l volumetric flask. Dilute to nearly 1 l with D.I. water, cool to room temperature, and dilute to 1 l. The amount of HCl required can be determined from the following equation:

$$y = \frac{77 \text{ ml} \times 0.15 \times}{0.9 \text{ M}}$$

*Mention of commercial products does not imply endorsement by the U.S. Environmental Protection Agency.

where:

y = ml of concentrated HCl required.

x = molarity of HCl in 6.2.6.

0.15 = dilution factor in 7.2.2.

6.2.8 Lead nitrate, $Pb(NO_3)_2$, ACS reagent grade, purity 99.0 percent. Heat for 4 hours at 120° C and cool in a desiccator.

6.3 Calibration standards.

6.3.1 Master standard, 1000 μg Pb/ml in HNO_3 . Dissolve 1.598 g of $Pb(NO_3)_2$ in 0.45 M HNO_3 , contained in a 1 l volumetric flask and dilute to volume with 0.45 M HNO_3 .

6.3.2 Master standard, 1000 μg Pb/ml in HNO_3/HCl . Prepare as in 6.3.1 except use the HNO_3/HCl solution in 6.2.7.

Store standards in a polyethylene bottle. Commercially available certified lead standard solutions may also be used.

7. Procedure.

7.1 Sampling. Collect samples for 24 hours using the procedure described in reference 10 with glass-fiber filters meeting the specifications in 6.1.1. Transport collected samples to the laboratory taking care to minimize contamination and loss of sample (16).

[7.1 corrected by 44 FR 37915, June 29, 1979]

7.2 Sample preparation.

7.2.1 Hot extraction procedure.

7.2.1.1 Cut a 3/4" x 8" strip from the exposed filter using a template and a pizza cutter as described in Figures 1 and 2. Other cutting procedures may be used.

Lead in ambient particulate matter collected on glass fiber filters has been shown to be uniformly distributed across the filter. Another study has shown that when sampling near a roadway, strip position contributes significantly to the overall variability associated with lead analyses. Therefore, when sampling near a roadway, additional strips should be analyzed to minimize this variability.

[7.2.1.1 corrected by 44 FR 37915, June 29, 1979]

7.2.1.2 Fold the strip in half twice and place in a 150-ml beaker. Add 15 ml of 3 M HNO_3 to cover the sample. The acid should completely cover the sample. Cover the beaker with a watch glass.

7.2.1.3 Place beaker on the hot-plate, contained in a fume hood, and boil gently for 30 min. Do not let the sample evaporate to dryness. Caution: Nitric acid fumes are toxic.

7.2.1.4 Remove beaker from hot plate and cool to near room temperature.

7.2.1.5 Quantitatively transfer the sample as follows:

7.2.1.5.1 Rinse watch glass and sides of beaker with D.I. water.

7.2.1.5.2 Decant extract and rinsings into a 100-ml volumetric flask.

7.2.1.5.3 Add D.I. water to 40 ml mark on beaker, cover with watch glass, and set aside for a minimum of 30 minutes. This is a critical step and cannot be omitted since it allows the HNO_3 trapped in the filter to diffuse into the rinse water.

7.2.1.5.4 Decant the water from the filter into the volumetric flask.

7.2.1.5.5 Rinse filter and beaker twice with D.I. water and add rinsings to volumetric flask until total volume is 80 to 85 ml.

7.2.1.5.6 Stopper flask and shake vigorously. Set aside for approximately 5 minutes or until foam has dissipated.

7.2.1.5.7 Bring solution to volume with D.I. water. Mix thoroughly.

7.2.1.5.8 Allow solution to settle for one hour before proceeding with analysis.

7.2.1.5.9 If sample is to be stored for subsequent analysis, transfer to a linear polyethylene bottle.

7.2.2 Ultrasonic extraction procedure.

7.2.2.1 Cut a 3/4" x 8" strip from the exposed filter as described in section 7.2.1.1.

7.2.2.2 Fold the strip in half twice and place in a 30 ml beaker. Add 15 ml of the HNO_3/HCl solution in 6.2.6. The acid should completely cover the sample. Cover the beaker with parafilm.

The parafilm should be placed over the beaker such that none of the parafilm is in contact with water in the ultrasonic bath. Otherwise, rinsing of the parafilm (section 7.2.2.4.1) may contaminate the sample.

7.2.2.3 Place the beaker in the ultrasonic bath and operate for 30 minutes.

7.2.2.4 Quantitatively transfer the sample as follows:

7.2.2.4.1 Rinse parafilm and sides of beaker with D.I. water.

7.2.2.4.2 Decant extract and rinsings into a 100 ml volumetric flask.

7.2.2.4.3 Add 20 ml D.I. water to cover the filter strip, cover with parafilm, and set aside for a minimum of 30 minutes. This is a critical step and cannot be omitted. The sample is then processed as in sections 7.2.1.5.4 through 7.2.1.5.9.

NOTE.—Samples prepared by the hot extraction procedure are now in 0.45 M HNO_3 . Samples prepared by the ultrasonication procedure are in 0.40 M HNO_3 + X M HCl.

8. Analysis.

8.1 Set the wavelength of the monochromator at 283.3 or 217.0 nm. Set or align other instrumental operating conditions as recommended by the manufacturer.

8.2 The sample can be analyzed directly from the volumetric flask, or an appropriate amount of sample decanted into a sample analysis tube. In either case, care should be taken not to disturb the settled solids.

8.3 Aspirate samples, calibration standards and blanks (section 9.2) into the flame and record the equilibrium absorbance.

8.4 Determine the lead concentration in μg Pb/ml, from the calibration curve, section 9.3.

8.5 Samples that exceed the linear calibration range should be diluted with acid of the same concentration as the calibration standards and reanalyzed.

9. Calibration.

9.1 Working standard, 20 μg Pb/ml. Prepared by diluting 2.0 ml of the master standard (6.3.1 if the hot acid extraction was used or 6.3.2 if the ultrasonic extraction procedure was used) to 100 ml with acid of the same concentration as used in preparing the master standard.

9.2 Calibration standards. Prepare daily by diluting the working standard, with the same acid matrix, as indicated below. Other lead concentrations may be used.

Volume of 20 μg /ml working standard, ml	Final volume, ml	Concentration μg Pb/ml
0	100	0
1.0	200	0.1
2.0	200	0.2
2.0	100	0.4
4.0	100	0.8
8.0	100	1.6
15.0	100	3.0
30.0	100	6.0
50.0	100	10.0
100.0	100	20.0

9.3 Preparation of calibration curve. Since the working range of analysis will vary depending on which lead line is used and the type of instrument, no one set of instructions for preparation of a calibration curve can be given. Select standards (plus the reagent blank), in the same acid concentration as the samples, to cover the linear absorption range indicated by the instrument manufacturer. Measure the absorbance of the blank and standards as in section 8.0. Repeat until good agreement is obtained between replicates. Plot absorbance (y-axis) versus concentration in μg Pb/ml (x-axis). Draw (or compute) a straight line through the linear portion of the curve. Do not force the calibration curve through zero. Other calibration procedures may be used.

To determine stability of the calibration curve, remeasure—alternately—one of the following calibration standards for every 10th sample analyzed: concentration $\leq 1 \mu g$ Pb/ml; concentration $\leq 10 \mu g$ Pb/ml. If either standard deviates by more than 5 percent from the value predicted by the calibration curve, recalibrate and repeat the previous 10 analyses.

10. Calculation.

10.1 Measured air volume. Calculate the measured air volume at Standard Temperature and Pressure as described in Reference 10.

[10.1 corrected by 44 FR 37915, June 29, 1979]

10.2 Lead concentration. Calculate lead concentration in the air sample.

$$C = \frac{(\mu g \text{ Pb/ml} \times 100 \text{ ml/strip} \times 12 \text{ strips/filter}) \times F_p}{V_{STP}}$$

where:

C=Concentration, $\mu\text{g Pb}/\text{sm}^3$.

$\mu\text{g Pb}/\text{ml}$ =Lead concentration determined from section 8.

100 ml/strip=Total sample volume.

12 strips = Total usable filter area 8" x 9"

filter = Total area of one strip 3/4 x 8"

F_b =Lead concentration of blank filter, μg , from section 6.1.1.2.3.

V_{STP} =Air volume from 10.2.

[10.2 corrected by 44 FR 37915, June 29, 1979]

11. Quality control

3/4" x 8" glass fiber filter strips containing 80 to 2000 $\mu\text{g Pb}/\text{strip}$ (as lead salts) and blank strips with zero Pb content should be used to determine if the method—as being used—has any bias. Quality control charts should be established to monitor differences between measured and true values. The frequency of such checks will depend on the local quality control program.

To minimize the possibility of generating unreliable data, the user should follow practices established for assuring the quality of air pollution data, (13) and take part in EPA's semiannual audit program for lead analyses.

12. Trouble shooting

1. During extraction of lead by the hot extraction procedure, it is important to keep the sample covered so that corrosion products—formed on fume hood surfaces which may contain lead—are not deposited in the extract.

2. The sample acid concentration should minimize corrosion of the nebulizer. However, different nebulizers may require lower acid concentrations. Lower concentrations can be used provided samples and standards have the same acid concentration.

3. Ashing of particulate samples has been found, by EPA and contractor laboratories,

to be unnecessary in lead analyses by atomic absorption. Therefore, this step was omitted from the method.

4. Filtration of extracted samples, to remove particulate matter, was specifically excluded from sample preparation, because some analysts have observed losses of lead due to filtration.

5. If suspended solids should clog the nebulizer during analysis of samples, centrifuge the sample to remove the solids.

13. Authority

(Secs. 109 and 301(a), Clean Air Act as amended, (42 U.S.C. 7409, 7601(a)).)

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[Corrected by 44 FR 37915, June 29, 1979]

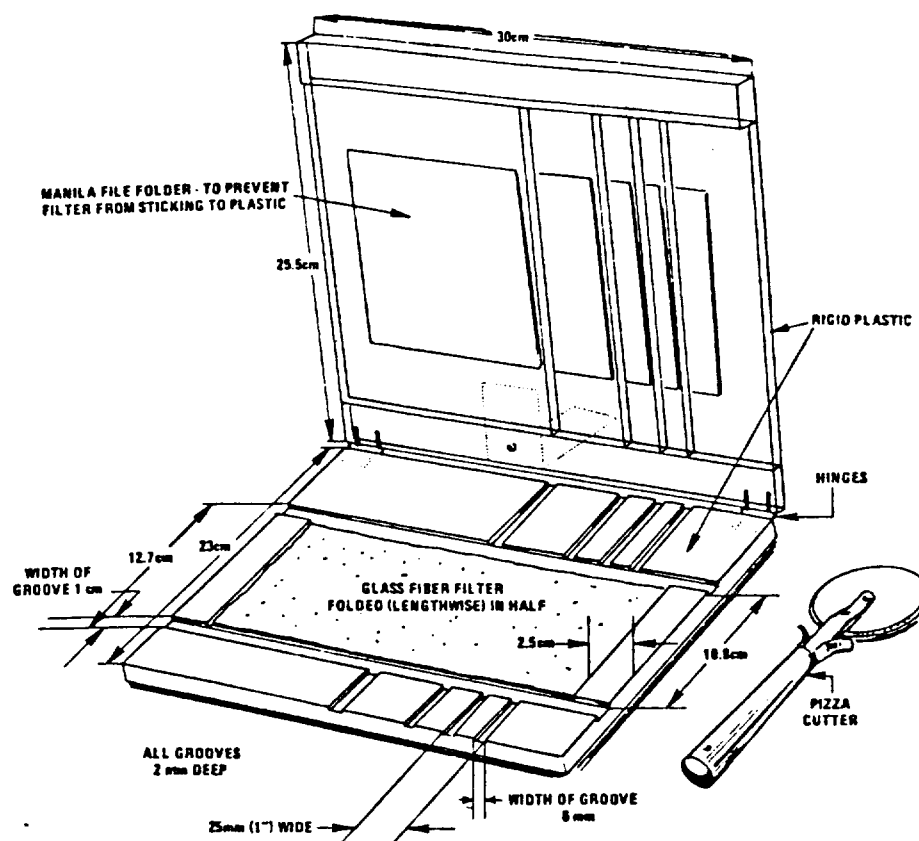


Figure 1

APPENDIX M-2-A

**SCOPE OF ADDITIONAL SITE INVESTIGATIONS IN RESPONSE
TO DRAFT RI REPORT REVIEW COMMENTS**



• ENGINEERS • CONSULTANTS • PLANNERS •

KUMAR MALHOTRA & ASSOCIATES INC.

3000 East Belt Line N.E.
Grand Rapids, Michigan 49505
Telephone (616) 361-5092

June 24, 1985
(Revised July 3, 1985)

Mr. Rodney Gaither
Project Coordinator (RPM) 5HE-12
USEPA, Region V
230 S Dearborn Street
Chicago, Illinois 60604

Re: Johns-Manville Waukegan Area RI/FS
(Additional site investigations in response to Draft RI Review Comments)

Dear Mr. Gaither,

This letter is to confirm our discussions on the following two tasks which involve additional site investigations. The data obtained through these tasks will be used to prepare responses to some of your review comments (items 3, 5 and 6 on page seven) on the draft RI report. These responses will be summarized in a technical memorandum and submitted for your review.

1. ANALYSIS OF COMMON INORGANIC ANIONS IN THE GROUND WATER.

As indicated by you, the purpose of the anion analysis of the ground water is to correlate if possible the ground water movement directions obtained by using temperature and elevations data with those obtained using major anion levels. Therefore, anions which are normally present in relatively large concentrations will be used to estimate ground water movement directions at the site. We propose to use the following measurements for this purpose.

Chlorides
Sulfates
Total alkalinity including carbonates
Specific conductance
Nitrates Nitrogen

We propose to analyze the ground water and Lake Michigan shore water samples for anions. The second set of samples which were collected on April 29 and 30, 1985 for asbestos analysis (as discussed in June, 1985 technical memorandum No. M-1) will be used for the anion data. If desired a second set of samples will be collected for repeating the anion analysis.

The results obtained will be used to plot ground water movement directions and compare with those obtained through the use of ground water temperature and elevation data.

Mr. Rodney Gaither
June 24, 1985
(Revised July 3, 1985)
Page Two

2. ON-SITE LEAD CONCENTRATION IN AIR

According to my discussion with you on the details of air sampling and to meet the intent of 40 CFR 50.12 on Ambient Air Lead concentrations, KMA proposes to sample air at nine locations (see attached figures 1 & 2 for on-site and off-site locations) on three different days, each for a period of 24 + hours. Air will be sampled according to the procedure outlined in Appendix G referred to in 40 CFR 50.12. In addition a portable wind vane and anemometer will be used at each location to obtain wind direction and wind velocity. If 0.10 inch of precipitation or more occurred during any test run, then that test run will be repeated after a waiting period of at least 24 hours. Standard high volume air samplers with glass fiber filter will be used. The air volume will be between 39 cfm (1.1 m³/min) and 60 cfm (1.7 m³/min).

The air filter will be the standard recommended for total suspended particulate matter (TSP) which has 99% capture efficiency to retain particles of 0.3 μ m diameter at 1.5 m³/min air rate. Air temperature and pressure will also be recorded at each location. The air flow rate for each sampler will be calibrated and recorded in a log book. The wind velocity and direction observations will be made three times during each test run. The sampling filters will be analyzed for lead using the USEPA recommended procedure. Blank filters and duplicates will be analyzed for quality control.

The field activities will be conducted during the week beginning July, 29, 1985 and will be coordinated with you so that you could witness some of the field sampling activities. The study will be summarized in a report. Based on the results of previous personal air sampling and results of remedial investigations, we propose to provide level D site health and safety protection during field activities.

The results obtained from the above two tasks will be submitted in the form of a technical memorandum by the 15th of September, 1985.

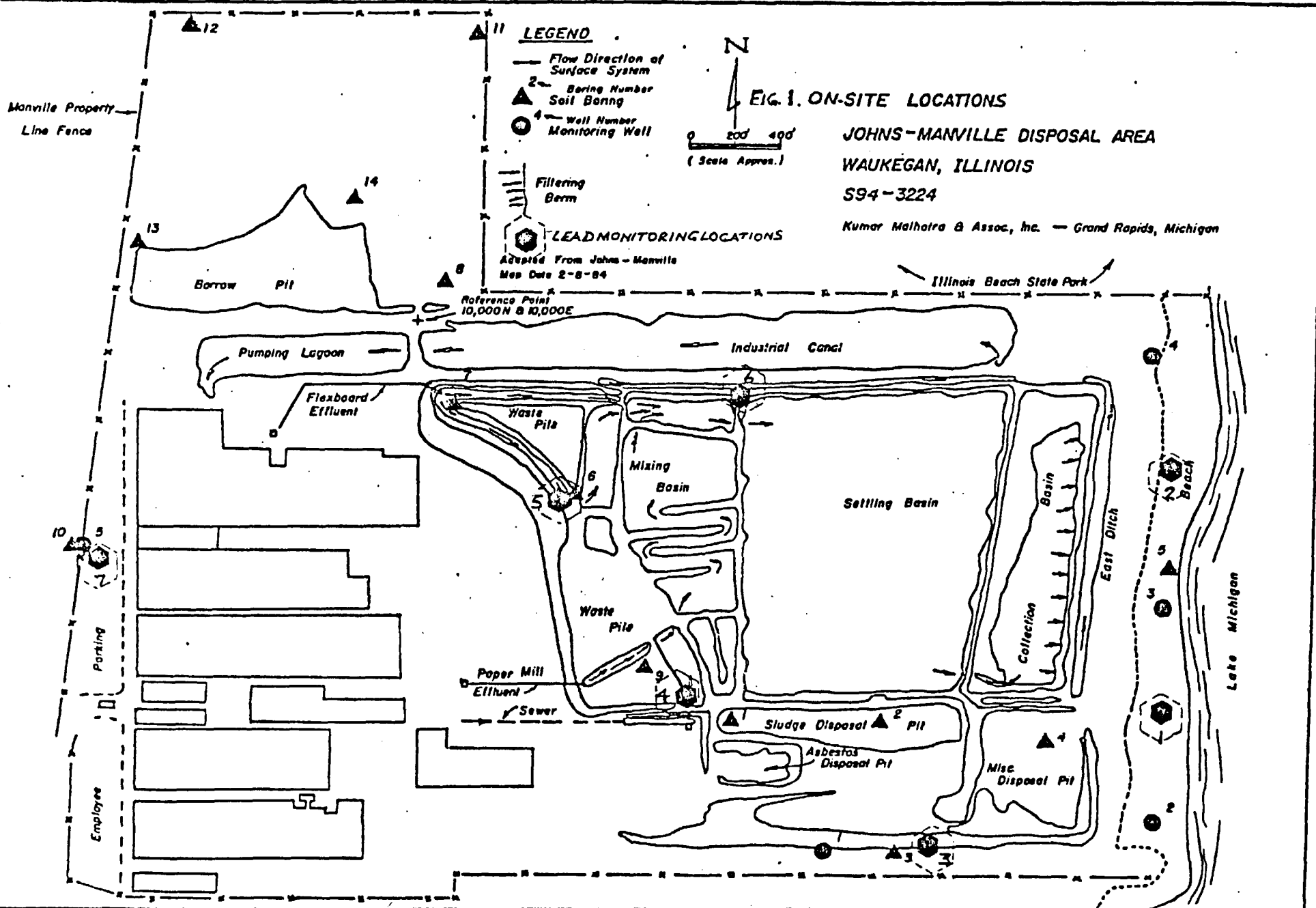
Please feel free to contact me if you have any questions on any of the information included in this letter.

Sincerely yours,



S. K. Malhotra, Ph.D., P.E.

cc: Mr. James Whipple, Johns-Manville
SKM:sa



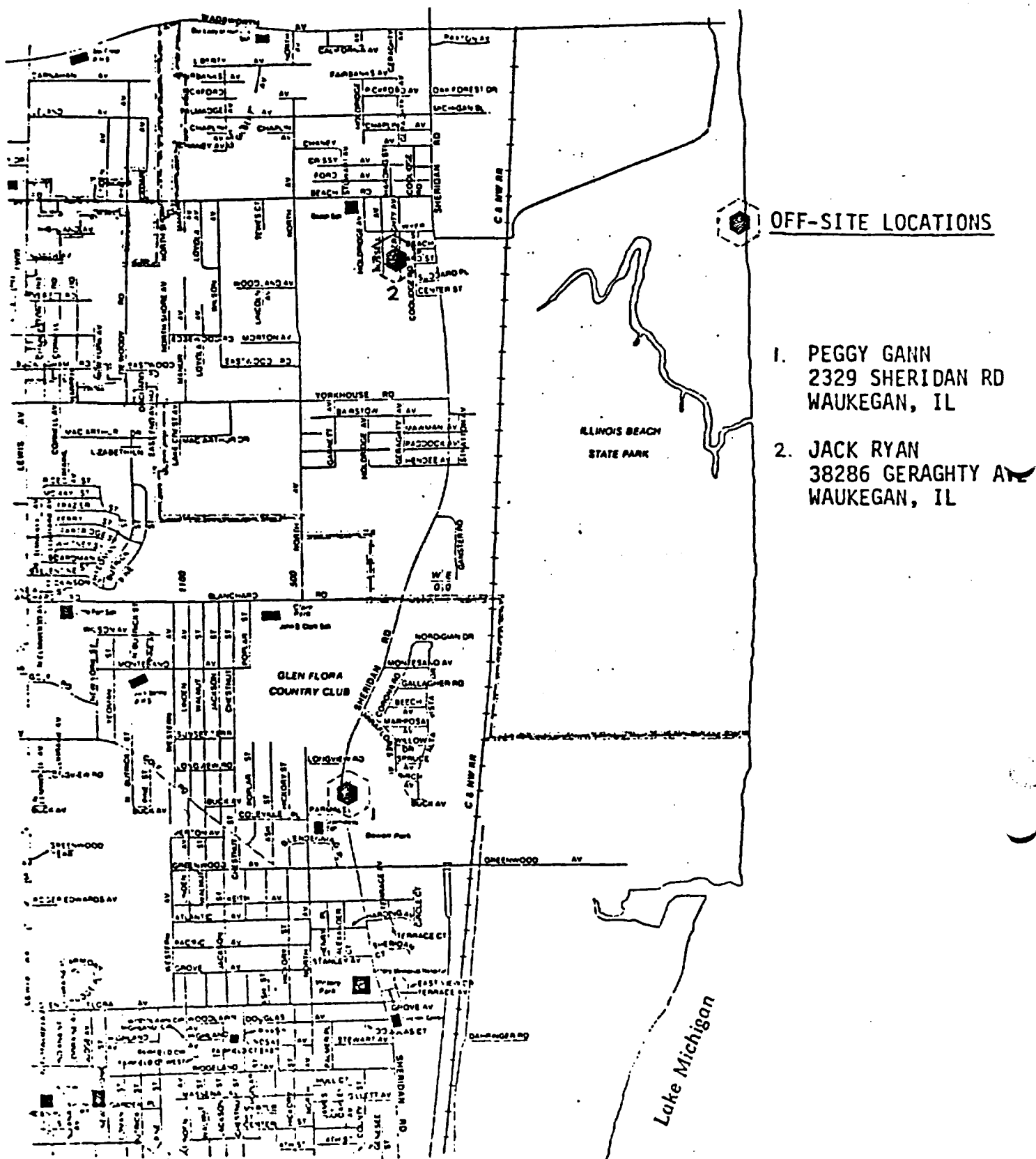


Figure 2 Locations of Off-Site Samplers.

APPENDIX M-2-B

1. COMMON INORGANIC ANIONS IN GROUND AND SURFACE WATERS

**2. APRIL 20, 1973 GROUND WATER SAMPLE ANALYSIS IN THE
VICINITY OF THE JOHNS-MANVILLE DISPOSAL AREA**



PREIN & NEWHOF, P.C.
ENGINEERS — SURVEYORS
ENVIRONMENTAL & SOILS LABORATORIES
3000 EAST BELT LINE N.E., GRAND RAPIDS, MICHIGAN 49505
285 JAMES STREET, SUITE E, HOLLAND, MICHIGAN 49423

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ROBERT J. VANDER MALE P.E.
ROBERT J. REIMINK P.E.
ARTHUR W. BRINTNALL R.L.S.
REX A. MILLIRON R.L.S.

July 15, 1985
85126

Dr. Kumar Malhotra
KMA Associates
3000 East Beltline NE
Grand Rapids, Michigan 49505

Re: Johns-Manville Samples, received in lab 6/24/85

LABORATORY RESULTS

<u>Sample</u>	<u>Specific Conductance umhos/cm</u>	<u>Chloride mg/L</u>	<u>Sulfate mg/L</u>	<u>Nitrate mg/L as N</u>	<u>Total Alka- linity, mg/L as Ca CO₃</u>
1, 4/28/85	1,330	116	113	2.26	591
2, 4/29/85	1,030	95	2	0.78	470
3, 4/30/85	700	75	39	0.87	233
4, 4/30/85	640	75	37	0.77	197
4A, 4/30/85	610	69	38	0.47	166
, 4/29/85	950	147	25	3.89	327
Water Plant Intake, 4/30/85	290	11	21	0.59	134
East of Well #2, Lake Shore, no date	300	11	22	0.16	112
East of Well #4, no date	303	12	23	0.39	139
50' N. of Con Edison Discharge no date	293	11	23	0.36	134

PREIN & NEWHOF

Jane Poch

Jane Poch
Chemist



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ARTHUR W. BRINTNALL R.L.S.
REX A. MILLIRON R.L.S.

August 23, 1985
85126

Dr. Kumar Malhotra
KMA Associates
3000 East Beltline NE
Grand Rapids, Michigan 49505

Re: Johns-Manville Samples received in lab 6/24/85 dated 4/28-30/85

<u>Sample</u>	<u>Total Alkalinity</u> <u>mg/L as CaCO₃</u>	<u>Bicarbonate</u> <u>Alkalinity</u> <u>mg/L as HCO₃⁻</u>	<u>Carbonate</u> <u>Alkalinity</u> <u>mg/L as CO₃⁼</u>
1	591	361	0
2	470	297	0
3	233	142	0
4	197	120	0
4A	166	101	0
5	327	199	0
Water Plant Intake	134	82	0
East of Well #2, Lakeshore	112	68	0
East of Well #4	139	85	0
50' N of Con Edison Discharge	134	82	0

PREIN & NEWHOF

Jane Hoch
Jane Hoch
Chemist

KMA Associates

August 23, 1985
85126

JOHNS-MANVILLE SAMPLES
RECEIVED 7/31/85
PREIN & NEWHOF LABORATORY RESULTS

LABORATORY RESULTS

<u>Sample</u>	<u>Specific Conductance umhos/cm</u>	<u>pH</u>	<u>Chloride mg/L</u>	<u>Sulfate mg/L</u>	<u>Nitrate mg/L as N</u>	<u>Total Alka- linity,mg/L as Ca CO₃</u>	<u>Bicarbonate mg/L as HCO₃⁻</u>	<u>Carbonate mg/L as CO₃</u>
1.	1,350	7.3	98	15	0.65	555	339	0
2.	1,210	7.1	82	2	0.01	587	297	0
3.	825	7.2	74	30	0.17	239	146	0
4.	825	7.5	76	31	0.01	194	118	0
5.	1,140	6.8	98	6	0.01	361	220	0
City Raw Tap	363	7.7	18	24	0.12	117	71	0
Ind.-Canal	725	8.2	66	146	0.01	113	69	0
C. Lake	360	7.9	9	24	0.13	113	69	0
N. Lake	360	7.9	9	26	0.09	113	69	0
S. Lake	350	7.7	9	24	0.11	113	69	0

NOTE: Samples 1 thru 5 represent Monitoring Wells # 1 thru 5 respectively.

C - Central Shore Line, East of Monitoring Well # 2

N - Northern Shore Line, East of Monitoring Well #4

S - Southern Shore Line, SE of Monitoring Well #2

STATE OF ILLINOIS

DEPARTMENT OF
REGISTRATION AND EDUCATION
DEAN BISHOP, CH

DIRECTOR, SPRINGFIELD

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SOUTHERN ILLINOIS UNIVERSITY

ROGER E. BEYLER

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WILLIAM L. EVERITT

Illinois State Water Survey

WATER RESOURCES BUILDING •
603 E. SPRINGFIELD, CHAMPAIGN

MAIL BOX 232, URBANA, ILLINOIS 61801

AREA CODE 217

PHONE 333-2211

WILLIAM C. ACKERMANN, CHIEF

April 20, 1973

MINERAL ANALYSIS

Sample of water collected March 26, 1973 from a well owned by Old City of Waukegan Lakeshore Site Well in Lake County. Location of well: 2300'E, 1400'N of the SW corner of Section 15-T45N-R12E. Depth of well: 30 feet.

LABORATORY NO. 191547

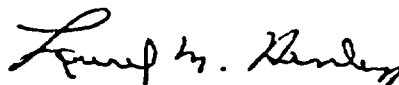
		mg/l	me/l			mg/l	me/l
Iron(total)	Fe	3.1		Phosphate(filt)	PO ₄	0.0	
Strontium	Sr	.61	.01	(unfilt)	PO ₄	0.0	
Sodium	Na	117	5.09	Nitrate	NO ₃	1.1	.02
Potassium	K	20.6	.53	Chloride	Cl	135	3.81
Barium	Ba	<0.1		Alkalinity	(as CaCO ₃)	412	8.24
Cadmium	Cd	.00					
Chromium	Cr	3.0	.17				
Copper	Cu	.01					
Lead	Pb	<.05					
Lithium	Li	.06	.01				
Nickel	Ni	<.05					
Zinc	Zn	.07					
Turbidity		23		Hardness	(as CaCO ₃)	630	12.60
Color		0		Total Dissolved Minerals		1138	
Odor		0					

mg/l = milligrams per liter

me/l = milliequivalents per liter

mg/l x .0583 = grains per gallon

ILLINOIS STATE WATER SURVEY



Laurel M. Henley
Associate Chemist
217-333-0802

LMH/pcb

APPENDIX M-2-C

**RELATED AIR QUALITY MONITORING DATA FOR
LEAD AND TSP FROM IEPA**

1980 AIR QUALITY MONITORING DATA
FOR LEAD IN THE WAUKEGAN AREA

This data was obtained from Carl Franson, Division of Air Quality, EPA,
Maywood, Illinois (312) 345-9780)

<u>Station</u>	<u>Annual Mean₃ in ug/m³</u>	<u>Quarterly Averages in ug/m³</u>			
		<u>1st Quarter 1980</u>	<u>2nd Quarter 1980</u>	<u>3rd Quarter 1980</u>	<u>4th Quarter 1980</u>
Island Lake	0.16	0.13	0.16	0.18	0.16
Lake Bluff (121 E. Sheridan Place)	0.21	0.18	0.18	0.28	0.18
Waukegan (Golf and Jackson)	0.30	0.31	0.35	0.31	0.26
Waukegan (106 Utica - downtown)	N/A	N/A	0.29	0.22	0.27



Illinois
Environmental
Protection Agency

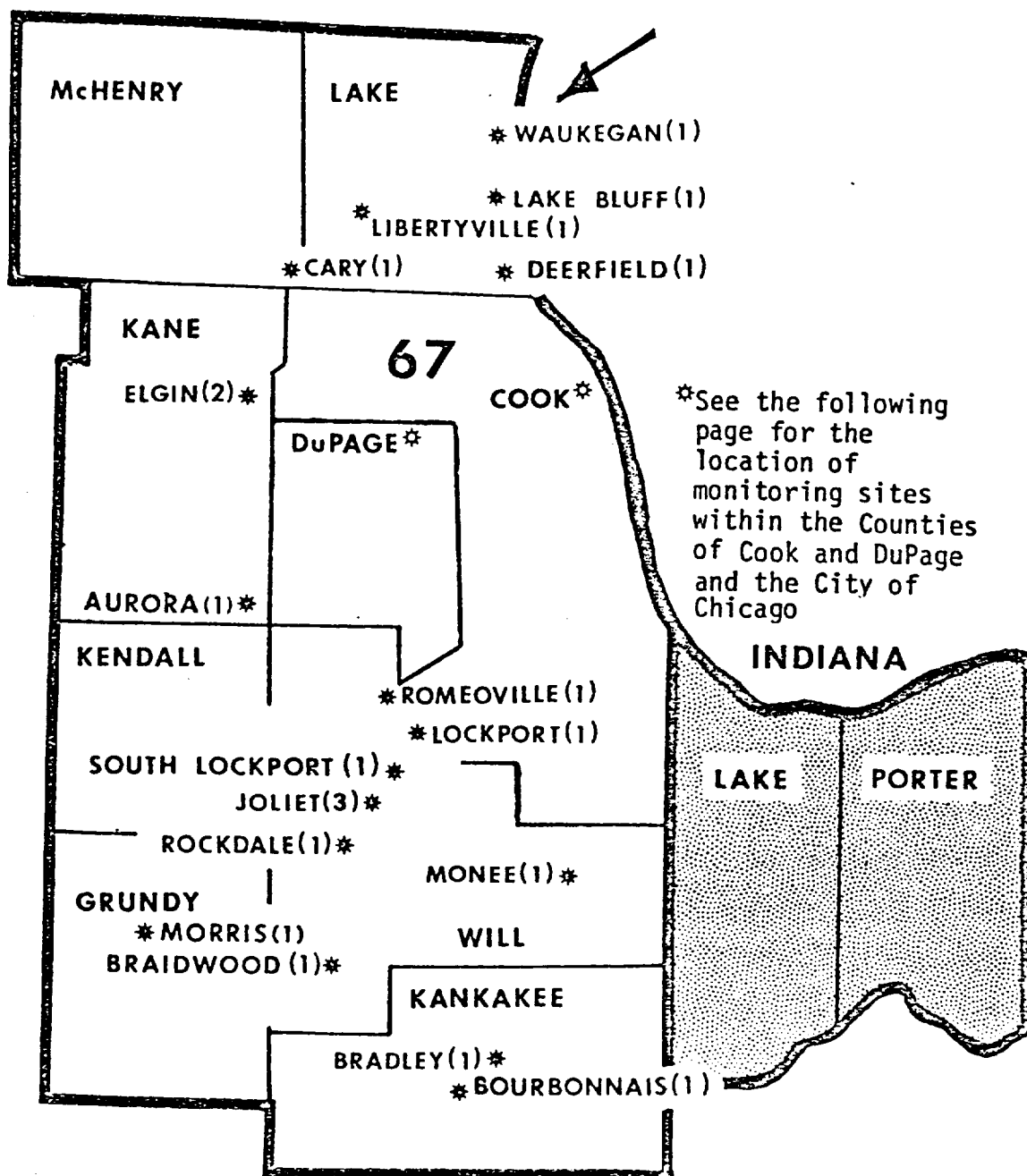
Division of Air Pollution Control
2200 Churchill Road
Springfield, Illinois 62706

June 1984

IEPA/APC/86-00G

ILLINOIS
ANNUAL
AIR QUALITY
REPORT
1 • 9 • 8 • 4

AIR QUALITY CONTROL REGION 67 METRO CHICAGO INTERSTATE (ILLINOIS - INDIANA)



Data for the Indiana portion of this control region can be obtained from:

Indiana State Board of Health
Air Pollution Control Division
1330 West Michigan Street
Indianapolis, Indiana 46206
(317) 633-0644

(The number of sampling sites in each city is shown in parenthesis following the city name.)

1984
SITE DIRECTORY

STATION	ADDRESS	OWNER/ OPERATOR	UTM COORD.	EQUIPMENT
Naperville (5480 001)	Fire Station 175 Jackson St.	Ill. EPA/DuPage Co. Health Dept.	N. 4624938 E. 404376	SLAMS - TSP
West Chicago (8080 002)	Police Station 128 W. McConnell Ave.	Ill. EPA/DuPage Co. Health Dept.	N. 4637626 E. 400080	SLAMS - TSP
Wheaton (8220 002)	Court House 201 Reber St.	Ill. EPA/DuPage Co. Health Dept.	N. 4635049 E. 408358	SLAMS - TSP
<u>GRUNDY COUNTY</u>				
Morris (5260 001)	County Courthouse 111 E. Washington	Ill. EPA	N. 4575130 E. 380975	SLAMS - TSP
<u>KANE COUNTY</u>				
Aurora (0220 002)	Fire Station 770 N. Michels	Ill. EPA	N. 4625339 E. 392376	NAMS - TSP
Elgin (2260 004)	Civic Center 150 Dexter Ct.	Ill. EPA	N. 4654734 E. 393654	NAMS - TSP SPMS - Pb
Elgin (2260 005)	Larsen Jr. H.S. 665 Dundee Rd.	Ill. EPA	N. 4655845 E. 394660	NAMS - SO ₂ , O ₃ SPMS - WS/WD ⁿ
<u>KANKAKEE COUNTY</u>				
Bourbonnais (0560 001)	Olivet Nazarene College	Ill. EPA	N. 4556000 E. 426460	SLAMS - O ₃
Bradley (0580 001)	East Elem. Sch. 610 E. Liberty St.	Ill. EPA	N. 4554462 E. 428259	SLAMS - TSP
<u>LAKE COUNTY</u>				
Deerfield (1760 001)	Woodland Park Elem. Sch. 1321 Wilmet Rd.	Ill. EPA	N. 4669574 E. 428580	NAMS - O ₃
Lake Bluff (4020 001)	East Elem. Sch. 121 E. Sheridan Place	Ill. EPA/Lake Co. Health Dept.	N. 4680333 E. 430166	SLAMS - TSP
Libertyville (4260 001)	Butterfield School 1441 Lake	Ill. EPA	N. 4682166 E. 419095	SLAMS - O ₃ SPMS - WS/WD
Waukegan (8020 002)	N. Fire Station Golf & Jackson	Ill. EPA	N. 4692840 E. 430760	NAMS - O ₃ SLAMS - TSP, SO ₂ SPMS - WD/WD
<u>MC HENRY COUNTY</u>				
Cary (1020 001)	Cary Grove H.S. 1st St. & Three Oaks Rd.	Ill. EPA/City H.S. (Hi-Vol)	N. 4674876 E. 397580	NAMS - O ₃ SLAMS - TSP
<u>WILL COUNTY</u>				
Braidwood (8220 007)	Sewage Plant Rt. 113 & School St.	Ill. EPA	N. 4570111 E. 397802	SLAMS - TSP, O ₃ , Pb SPMS - WS/WD ⁿ
Collet (13760 002)	Pershing School Midland & Campbell	Will County Health Dept.	N. 4597641 E. 406864	NAMS - TSP SLAMS - Pb
Collet (13760 003)	Rivals Park 1425 N. Broadway	Will County Health Dept.	N. 4600253 E. 409086	SLAMS - TSP
Collet (13760 012)	Will County Court House Ottawa & Washington	Ill. EPA	N. 4597226 E. 409698	SLAMS - CO NAMS - SO ₂ ⁿ

4.7 LEAD SUMMARIES

The lead component of the TSP measurements was analyzed at 53 locations in Illinois in 1984. None of the sites recorded a violation of the quarterly lead standard of 1.5 ug/m^3 . The highest quarterly lead average in 1984 was 1.48 ug/m^3 recorded at 15th and Madison in Granite City. The highest quarterly lead average in the Chicago area was 0.68 ug/m^3 at 3500 East 114th Street in Chicago.

The following table lists the Statewide lead summaries for 1984.

1984
LEAD

(MICROGRAMS PER CUBIC METER)

STATION	ADDRESS	NUMBER OF QUARTERS >1.5 ug/m ³	QUARTERLY AVERAGES (ug/m ³)				ANNUAL MEAN (ug/m ³)
			1st	2nd	3rd	4th	
65 BURLINGTON-KEOKUK INTERSTATE (IOWA - ILL.)							
<u>PEORIA COUNTY</u>							
Peoria	610 N.E. Jefferson	0	0.19	0.20	0.15	0.27	0.20
67 METROPOLITAN CHICAGO INTERSTATE (ILL. - IND.)							
<u>COOK COUNTY</u>							
Alsip	4500 W. 123rd St.	0	0.23	0.29	0.18	0.23	0.23
Arlington Heights	33 S. Arlington Hts. Rd.	0	0.24	0.21	0.16	0.20	0.20
Blue Island	12700 Sacramento	0	0.26	0.33	+	-	+
Calumet City	755 Pulaski Road	0	0.24	0.27	0.20	0.17	0.22
Chicago	10810 S. Ave. H	0	0.40	0.44	0.32	0.25	0.35
Chicago	9800 S. Torrence	0	0.33	0.31	0.29	0.25	0.29
Chicago	10740 S. Calhoun	0	-	-	0.27	+	+
Chicago	8131 S. May St.	0	0.26	0.21	0.13	0.12	0.18
Chicago	801 E. 133rd Pl.	0	0.28	0.23	0.31	0.35	0.29
Chicago	735 W. Harrison	0	0.52	0.45	0.51	0.59	0.52
Chicago	805 N. Michigan Ave.	0	0.37	0.29	0.28	0.29	0.31
Chicago	2100 E. 87th St.	0	0.34	0.34	0.29	0.27	0.31
Chicago	1450 Larrabee	0	0.34	0.19	0.30	0.26	0.27
Chicago	5358 N. Ashland	0	0.24	0.20	0.21	0.30	0.24
Chicago	3300 S. Michigan Ave.	0	0.30	0.24	0.27	0.37	0.30
Chicago	11220 S. Wallace	0	0.22	0.25	0.23	0.31	0.25
Chicago	6140 S. Melvina Ave.	0	+	0.29	0.25	0.18	+
Chicago	2940 W. Cortland Ave.	0	0.28	0.23	0.26	0.32	0.27
Chicago	4850 Wilson Ave.	0	0.51	0.38	0.38	0.37	0.41
Chicago	3300 E. Cheltenham Pl.	0	0.24	0.18	0.19	0.27	0.22
Chicago	6631 N. Bosworth Ave.	0	0.17	0.13	0.12	0.13	0.14
Chicago	3500 E. 114th St.	0	0.48	0.68	0.50	0.45	0.53
Chicago Heights	Dixie Hwy & 10th St.	0	+	0.21	0.12	0.20	+
Cicero	15th St. & 50th Ave.	0	0.38	0.41	0.41	0.32	0.38
DesPlaines	180 E. Thacker	0	0.22	0.17	0.14	+	+
DesPlaines	2nd Ave. & Thacker	0	-	-	-	+	+
Flossmoor	999 Kedzie Avenue	0	0.17	0.23	0.12	0.13	0.16
Harvey	157th & Lexington St.	0	0.27	0.32	0.20	0.22	0.25
Lemont	206 Main St.	0	0.11	0.10	0.10	0.21	0.13
Lyons	4043 Joliet Ave.	0	0.29	0.26	0.21	0.23	0.25
Maywood	1500 Maybrook Dr.	0	0.43	0.36	0.29	0.27	0.34
Miles	8955 Greenwood Ave.	0	0.25	0.21	0.15	0.22	0.21
Palatine	1000 Quentin Rd.	0	0.15	0.15	0.07	0.12	0.12
River Forest	Lathrop & Oak	0	0.26	0.25	0.15	0.21	0.22
Summit	60th St. & 74th Ave.	0	0.24	0.23	0.15	0.18	0.20
<u>DU PAGE COUNTY</u>							
Elmhurst	118 Schiller	0	0.22	0.15	0.18	0.17	0.18
<u>KANE COUNTY</u>							
Elgin	150 Dexter Ct.	0	0.21	0.15	0.16	0.18	0.18

1984
LEAD

(MICROGRAMS PER CUBIC METER)

STATION	ADDRESS	NUMBER OF QUARTERS >1.5 ug/m ³	QUARTERLY AVERAGES (ug/m ³)				ANNUAL MEAN (ug/m ³)
			1st	2nd	3rd	4th	
<u>WILL COUNTY</u>							
Braidwood	Rte. 113 & School St.	0	0.10	0.05	0.06	0.06	0.07
Joliet	Midland & Campbell Sts.	0	0.20	0.13	0.13	0.16	0.16
69 METROPOLITAN QUAD CITIES INTERSTATE (ILL. - IOWA)							
<u>ROCK ISLAND COUNTY</u>							
East Moline	915 16th Ave.	0	0.14	0.10	0.14	0.13	0.13
70 METROPOLITAN ST. LOUIS INTERSTATE (ILL. - MO.)							
<u>MADISON COUNTY</u>							
Granite City	23rd & Madison	0	0.35	0.29	0.23	0.28	0.29
Granite City	2001 E. 20th	0	-	-	+	0.28	+
Granite City	15th & Madison	0	1.48	0.77	0.34	0.40	0.75
Granite City	Roosevelt & Rock Rd.	0	0.33	0.31	0.23	0.27	0.29
Granite City	20th & Adams	0	0.31	0.29	0.23	0.26	0.27
Granite City	17th & Cleveland	0	0.74	0.74	0.40	0.45	0.58
Wood River	54 N. Walcott	0	0.35	0.33	0.27	0.32	0.32
<u>ST. CLAIR COUNTY</u>							
East St. Louis	13th & Tudor	0	0.49	0.41	0.40	0.44	0.44
73 ROCKFORD-JAMESVILLE-BELOIT INTERSTATE (ILL. - WIS.)							
<u>WINNEBAGO COUNTY</u>							
Rockford	204 S. 1st St.	0	+	0.13	0.14	0.17	+
74 SOUTHEAST ILLINOIS INTRASTATE							
<u>JACKSON COUNTY</u>							
Carbondale	300 N. Springer	0	0.11	0.09	0.10	0.08	0.09
75 WEST CENTRAL ILLINOIS INTRASTATE							
<u>MACON COUNTY</u>							
Decatur	2300 Geddes	0	0.20	0.18	0.15	0.15	0.17
<u>MACOUPIN COUNTY</u>							
Wilwood	IEPA Trailer	0	0.06	0.07	0.05	0.02	0.05
PH:bv/sp/0851E/1-2							

PH:bv/sp/0851E/1-2

1984
TOTAL SUSPENDED PARTICULATES
(MICROGRAMS PER CUBIC METER)

STATION	ADDRESS	NUMBER OF SAMPLES			HIGHEST SAMPLES				ANNUAL STATISTICS	
		TOTAL	>150 UG/M ³	>260 UG/M ³	1st	2nd	3rd	4th	GEOMETRIC MEAN	STD. GEO DEVIATION
Chicago	3300 E. Cheltenham Pl.	58	0	0	122	110	109	106	47	1.9
Chicago	6631 N. Bosworth Ave.	57	0	0	109	93	86	79	39	1.6
Chicago	3500 E. 114th St.	54	10	0	240	233	216	203	85	1.7
Chicago Heights	Dixie Hwy & 10th St.	52	0	0	123	111	99	87	+	
Cicero	15th St. & 50th Ave.	59	0	0	146	139	137	124	69	1.5
DesPlaines	180 E. Thacker	46	0	0	106	103	91	86	+	
DesPlaines	2nd Ave. & Thacker	9	0	0	80	64	62	45	+	
Evanston	1454 Elmwood	59	1	0	188	126	101	95	47	1.6
Flossmoor	999 Kedzie Ave.	59	0	0	115	108	98	92	46	1.5
Harvey	157th & Lexington St.	56	0	0	135	127	123	118	56	1.6
Lemont	206 Main St.	56	1	0	170	138	129	127	68	1.5
Lyons	4043 Joliet Ave.	53	2	0	222	178	134	129	65	1.
McCook	50th & Glencoe	52	7	1	398	218	218	165	71	1.6
Maywood	1500 Maybrook Dr.	51	0	0	135	128	122	119	58	1.6
Miles	8955 Greenwood Ave.	57	0	0	142	122	105	105	49	1.
Palatine	1000 Quentin Rd.	52	0	0	111	95	90	78	41	1.6
River Forest	Lathrop & Oak St.	58	0	0	122	112	104	95	49	1.6
Summit	60th St. & 74th Ave.	59	1	0	179	129	128	127	64	1.6
Winnetka	1112 Willow Rd.	51	0	0	108	87	81	79	+	
<u>DU PAGE COUNTY</u>										
Addison	130 W. Army Trail Rd.	51	0	0	108	94	93	86	47	1.5
Bensenville	Main St. & York Rd.	46	0	0	144	121	115	108	+	
Darien	1410 75th St.	53	0	0	112	101	92	75	45	1.5
Elmhurst	718 Schiller	53	0	0	112	104	101	83	47	1.5
Naperville	175 Jackson St.	50	0	0	142	130	114	113	50	1.6
West Chicago	128 W. McConnell Ave.	56	0	0	137	111	95	85	44	1.6
Wheaton	201 Reber St.	55	0	0	110	107	99	96	44	1.5
<u>GRUNDY COUNTY</u>										
Morris	111 E. Washington	59	0	0	145	133	108	102	41	1.
<u>KANE COUNTY</u>										
Aurora	770 N. Michels	60	0	0	113	99	97	81	40	1.6
Elgin	150 Dexter Ct.	52	0	0	93	92	91	80	42	1.5
<u>KANKAKEE COUNTY</u>										
Bradley	610 E. Liberty	53	0	0	141	124	105	93	49	1.5
<u>LAKE COUNTY</u>										
One Cliff	121 E. Sheridan Pl.	53	0	0	123	85	76	72	34	1.7
Deerfield	Golf & Jackson	55	0	0	118	106	94	93	42	1.6
<u>MC HENRY COUNTY</u>										
Day	1st St. & Three Oaks Rd.	57	0	0	108	88	86	79	37	1.6
<u>WILL COUNTY</u>										
Woodstock	Rte. 113 & School St.	52	0	0	127	113	99	98	39	1.9
York	Midland & Campbell Sts.	54	3	1	356	257	171	106	53	1.5
York	1425 N. Broadway	53	0	0	129	126	105	102	44	1.6
York	5th & Madison	56	0	0	125	117	114	93	44	1.6
York	432 E. Main	49	0	0	132	117	114	109	42	1.7
York	Midland & Otis	53	0	0	139	133	93	89	54	1.5
York	Naperville Rd.	46	0	0	106	91	88	85	+	